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PHYSICS ABSTRACTS

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SECTION A OF SCIENCE ABSTRACTS

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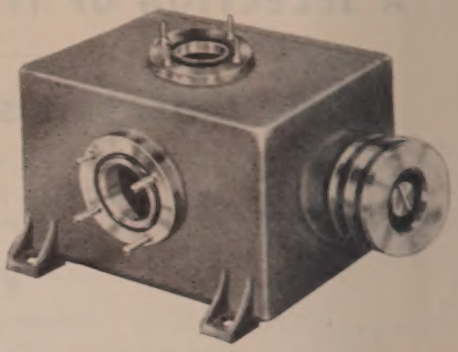

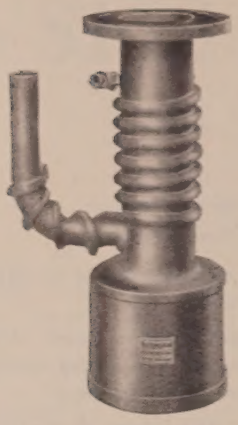

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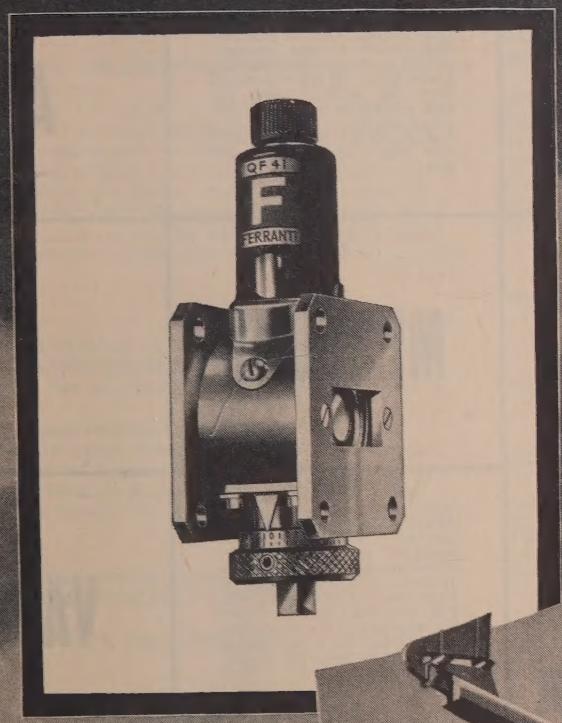

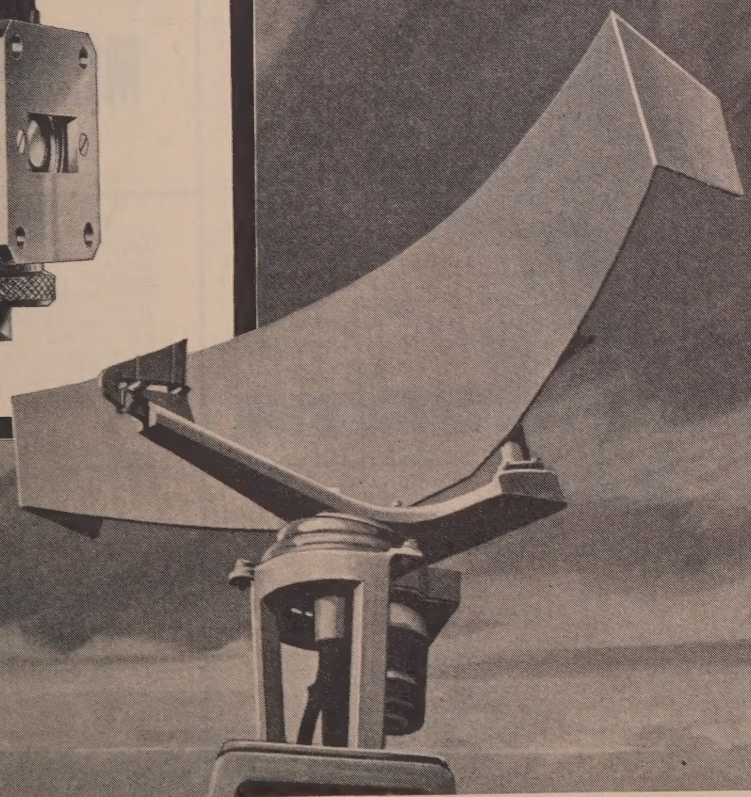

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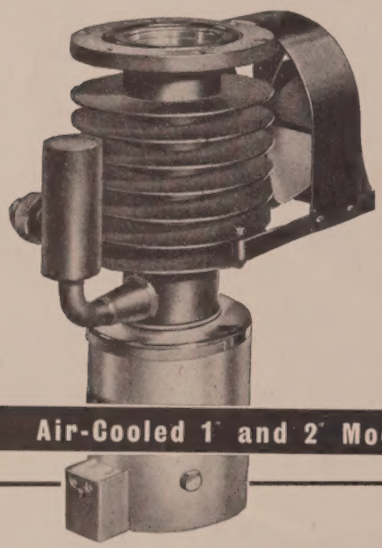

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lume 62 DECEMBER 1959 Number 744

MATHEMATICS

517 : 948

931. ON THE SOLUTION OF AN EIGENVALUE EQUATION OF HE WIENER–HOPF TYPE IN FINITE AND INFINITE RANGES. Mittra.
R.E. Nat. Convention Record, Vol. 7, Pt 4, 170-3 (1959).

The purpose of the paper is to present a formulation of the genvalue matrix equation of the Wiener–Hopf integral equation fined in finite and infinite ranges. The method provides a simple eans for obtaining the eigenvalue equation and indicates a way for taining the eigenfunctions and the eigenvalue. The important ntribution of the paper is the direct rather than the transform ethod of solution. Such a formulation is also helpful in the solution inhomogeneous Wiener–Hopf equation in finite and infinite ranges.

517.52

932. A METHOD FOR THE HURWITZ FACTORING OF A OLYNOMIAL. R.Unbehauen.
ch. elekt. Ubertragung, Vol. 13, No. 2, 58-62 (Feb., 1959).

A method is devised that yields the Hurwitz factorization of a lynomial without an explicit determination of the zeros of the rwitz factor. With this method a polynomial, derived from the lynomial to be factorized by a broken-linear transformation of riables, is resolved into factor polynomials, of which each has ly zeros of the same modulus and that give directly the desired rwitz factor. The method is practically demonstrated by reference an example. S.C.Dunn

517.9 : 530.145

933. RELATIONS BETWEEN THE POLYNOMIAL METHOD ND THE FACTORIZATION METHOD. Z.Królikowska.
ull. Acad. Polon. Sci. Ser. Sci. math. astron. phys., Vol. 7, No. 3, 7-68 (1959).

Connections are found between the methods of Rubinowicz bstr. 6934 of 1950) and Infeld (Abstr. 5973 of 1951) for solving genvalue problems for the finite interval problem. In particular, is shown that all factorizable problems can be treated by the lynomial method, but the reverse is not true. P.Roman

518.4

934. A NEW APPARATUS FOR THE GRAPHICAL FFERENTIATION OF EMPIRICALLY GIVEN CURVES. Kratky and Z.Skala.
InstrumKde, Vol. 67, No. 7, 186-7 (July, 1959). In German.

A series of circles of curvature is marked on a transparent disk. In order to determine slope, tangent and curvature at a certain point of the given curve, the disk is placed upon the curve, and by means of relative turning of the disk the circle of curvature is selected, which fits best as an osculating circle at the desired point. The required quantities may then be measured directly or obtained by means of a special machine. The authors claim an accuracy of 10 minutes of arc for slope of curve, and point out that the second differential coefficient can be found from slope and curvature, possibly by using a nomogram. N.L.Johnson

518.5 : 621.317.79

12935. ON THE APPLICATION OF AN ELECTRONIC DIFFERENTIAL ANALYSER FOR FINDING THE ROOTS OF A POLYNOMIAL. B.R.Nag.
Indian J. Phys., Vol. 32, No. 5, 212-17 (May, 1958).

A method of finding the roots of a polynomial with real coefficients by an electronic differential analyser is described. The principle underlying the method is to set up in the analyser a system having a transfer function, of which the numerator is the polynomial whose roots are to be obtained. The denominator of the transfer function is a suitably chosen polynomial. Roots of the polynomial are then obtained by determining the frequencies at which the system gives zero output.

518.5 : 535.33

APPLICATION OF A DIGITAL COMPUTER TO THE ZEEMAN METHOD IN ATOMIC SPECTROSCOPY. See Abstr. 11990

518.5 : 534.1

THE PARALLEL-CIRCUIT EQUIVALENT OF MECHANICAL VIBRATIONS. See Abstr. 11917

519 : 548.735.4

FITTING A PLANE OR A LINE TO A SET OF POINTS BY LEAST SQUARES. See Abstr. 13917

519.2

12936. AN OSCILLOGRAPHIC METHOD OF MEASUREMENT OF THE DISTRIBUTION LAWS OF RANDOM MAGNITUDES. I.G.Akopyan.
Pribory i Tekh. Eksper., 1959, No. 1, 137 (Jan.-Feb.). In Russian.

A short description of a simple circuit which uses two CRTs and a photo-cell to obtain a direct display of the distribution curve of a random process. P.Collins

.1

ASTROPHYSICS

522.61

12937. CONSTRUCTION OF A SCHMIDT CAMERA. S.L.Mallick.
J. sci. indust. Res., Vol. 18A, No. 6, 268-73 (June, 1959).

After a brief outline of the theory of a Schmidt camera, the grinding, polishing and optical testing of a 12 in. diameter mirror and its corrector plate are described in detail. The paper only deals with the optical components and does not consider mechanical construction at all R.W.Fish

522.61 : 535.345.6

TRANSMISSION OF SHARP CUT-OFF GLASS FILTERS.
See Abstr. 13172

522.611

12938. A NEW H-ALPHA MONOCHROMATOR (LYOT FILTER). M.Haase and H.G.Häfele.
Z. InstrumKde., Vol. 67, No. 5, 113-18 (May, 1959). In German.

The new apparatus, designed for solar patrol work, is based on the Lyot polarizing interference filter. It transmits at the red Hα line, 6563 A. The alternative band-pass values of 0.75 or 3.0 A are maintained to a high degree of constancy by thermostatically-controlled electrical heating of the enclosure containing the crystal-optical components. D.R.Barber

522.617

12939. AN IMPROVED METHOD FOR MEASURING EXTINCTION. R.Hardie.
Astrophys. J., Vol. 130, No. 2, 663-9 (Sept., 1959).

A practical method is described for obtaining accurate extinction coefficients and zero-point terms for both magnitudes and colours. All necessary observations may be secured in a short time, of the order of 30 minutes, and the resulting extinction coefficients have an accuracy of about 2% for magnitude and 3% for colours. The use of nightly values of the coefficients, determined in this manner, results in higher-quality photometry and permits the use of less transparent skies than is the case when mean values are used. The relationships between the colour coefficients and the magnitude coefficient are noted for a wide range of observing conditions.

523.11

12940. THE DIFFERENTIAL EQUATIONS OF A DYNAMICAL MODEL UNIVERSE. H.Rüssmann.
Z. Astrophys., Vol. 48, No. 1, 39-51 (1959). In German.

If the velocity field in Heckmann's Newtonian cosmology (Abstr. 870 of 1956) is taken to be $v_i = a_i(t)x_i$, the coefficients a_i satisfy the equations

$$\dot{a}_i + a_i^2 + \sigma = 0,$$

$$\dot{\sigma} + (a_1 + a_2 + a_3)\sigma = 0,$$

where $\sigma(t)$ is proportional to the density. The nature of solutions of these equations in the neighbourhood of singularities is discussed. It is shown that solutions with positive density can either be "elliptic", being regular in $t_1 < t < t_2$ with singularities at t_1 and t_2, or "parabolic" or "hyperbolic", being regular in a semi-infinite interval, the two latter cases differing in asymptotic behaviour as $|t| \to \infty$. R.A.Newing

523.11

12941. EVOLUTION OF VERY MASSIVE STARS.
M.Schwarzschild and R.Härm.
Astrophys. J., Vol. 128, No. 2, 348-60 (Sept., 1958).

Models for the initial state and for the early evolution phases of stars with masses between 30 and 200 solar masses have been constructed. It was found that, as evolution proceeds in these very massive stars, the convective instability moves outward. This effect is caused by the low values of γ produced by the radiation pressure. In consequence, an intermediate semiconvective zone develops in which the convection is so slow that it does not contribute to the energy transport but is fast enough to modify the composition, so that convective neutrality is maintained in every layer of this zone throughout the early evolution phases. The resulting models show that these very massive stars will use up as much as two-thirds of their total initial hydrogen content before exhaustion in the core occurs. Accordingly, the evolution proceeds somewhat more slowly for these stars than had previously been estimated; even a star of 200 solar masses spends over two million years in the evolutionary phases before its core gets exhausted.

523.1

12942. THE EVOLUTION OF ROTATING SYSTEMS OF GRAVITATING BODIES. T.A.Agekian.
Astron. Zh., Vol. 35, No. 1, 26-36 (1958). In Russian. English translation in: Soviet Astron.–AJ (New York), Vol. 2, No. 1, 22-31 (Jan.-Feb., 1958).

Rotating systems of gravitating bodies which have acquired equilibrium shapes evolve by diffusion. The bodies diffusing out of any element of volume carry off, on the average, more than the average angular momentum per body in the volume. Expressions are derived for $a(z, \alpha)$, the fraction of stars diffusing out of a given volum in the relaxation time, and for $\varphi(z, \alpha)$, the ratio between the excess angular momentum carried off and the mean angular momentum. The quantity z is proportional to the ratio between the linear velocity of the centroid and the mean velocity of the bodies relative to the centroid, and α is the ratio of the mean square critical velocity to the total velocity of the bodies. On the average in a given syste $\alpha = 4$. A volume element for which $\alpha = 4$ evolves in a way which is characteristic for the system. A table is compiled for $a(z, 4)$ and $\varphi(z, 4)$. It is shown that the set of all rotating systems of gravitati bodies can be divided into two evolutionary sequences. The system for which $z < 1.268$ (flattening < 0.740) form a spherical evolutionary sequence. In these systems z and the flattening decrease continuously in the evolutionary process. For the flat evolutionary sequence ($z > 1.268$, flattening > 0.740) z and the flattening increase i the evolutionary process. Differential equations are derived for th evolutionary variation of z, the angular velocity ω, the linear velo city c of the centroid, the mean velocity $\bar{v}$ relative to the centroid the relaxation time τ, and the number of bodies n. These equation are solved numerically, and the results are tabulated. A formula i derived relating z and the parameter κ which characterizes flatte ing. The phenomenon of differential evolution of a system of the fla sequence is discussed. In this process the central part of the system becomes thicker and the peripheral regions become flatter. T time (in units of the relaxation time) it takes a rotating system to g from a state with one value of z into another with a different value of z is calculated.

523.16

12943. EFFECTS OF INTRACLUSTER GAS AND DUST UPON THE VIRIAL THEOREM. D.N.Limber.
Astrophys. J., Vol. 130, No. 2, 414-28 (Sept., 1959).

In the present paper the application of the virial theorem to clusters of galaxies (or stars) is re-examined for the case in whic a significant fraction of the total mass of the cluster exists in the form of intracluster gas. A modified form for the expression of th virial theorem in this case is obtained in terms of the mean-squar velocity of the galaxies, the total mass of the galaxies, the total mass of the gas, the radius of the cluster, a coefficient depending upon the spatial distribution of the galaxies, and a second coefficie depending upon both the spatial distribution of the galaxies and the spatial distribution of the gas — the two distributions being differ ent in general. The two coefficients are evaluated and tabulated fo those cases in which the two distributions can be approximated by the polytropic distributions with integral indices. It is shown how the coefficients corresponding to more general distributions can b approximated by means of the tabulated coefficients.

523.161 : 551.521.32

12944. INTERPLANETARY GAS. I. HYDROGEN RADIATION IN THE NIGHT SKY. J.C.Brandt and J.W.Chamberlain.
Astrophys. J., Vol. 130, No. 2, 670-82 (Sept., 1959).

Lyman-α in the light of the night sky seems to be produced through resonance scattering of solar Ly-α by H in the interplanet ary medium. Arguments are given against the hypothesis that the radiation might originate in a geocorona (extended outer atmosphe of the earth). The radiative-transfer problems of diffuse reflectio by the atmosphere, of the night-sky radiation and of the solar emis sion, are treated. The Ly-α airglow observed between 85 and 120 could arise entirely from scattering of the night-sky radiation if th latter originated in a geocorona. But if, as seems to be the case, interplanetary gas is responsible, the airglow can be attributed to albedo effect only for a rather large (but not impossible) value of t

hydrogen abundance in the upper atmosphere, and it seems likely that an additional source of Ly-α radiation may be present. The intensity distribution over the night-sky indicates that the H is located principally within 1 a.u. of the earth. This intensity distribution and the observed intensity ratio, Ly-α/Hα, tend to substantiate the assumption made here that the interplanetary gas is optically thin for Ly-α. The H density implied by the night-sky intensity is at least 0.2 atom/cm^3 in the neighbourhood of the earth. The position of H in the solar system and the optical thickness may be investigated further by measurements of Ly-α polarization, computed here for an optically thin model. The data available so far do not provide a determination of the temperature of interplanetary H, but it could be derived from accurate measurements of the solar emission profile, the daytime albedo, and the variation with rocket altitude of the night-sky intensity in various directions.

523.162

12945. PHOTOELECTRIC MEASUREMENTS OF INTERSTELLAR ABSORPTION. R.Bouigue.
C.R. Acad. Sci. (Paris), Vol. 248, No. 21, 2956-8 (May 25, 1959). In French.

Using the Lallemand photocell with an 80 cm telescope, the author measured 30 stars of spectral types between O-6 and B-3 in an attempt to determine the relative masses of absorbing matter. The same stars were previously investigated spectrophotometrically by Divan [Ann. Astrophys., Vol. 17, 456 (1954)]. The measurements of the author were carried out in the B, V system of Johnson and Morgan [Astrophys, J., Vol. 117, 313 (1953)]. The results obtained in the Orion nebula bear out Divan's conclusions. F.Lachman

523.164

12946. THE APPLICATION OF INTERFEROMETRIC RECEPTION TO THE RECORDING OF HIGH-SPEED TIME PROCESSES.
V.V.Vitkevich and V.A.Udal'tsov.
Radioteknika i Elektronika, Vol. 3 No. 6, 784-93 (1958). In Russian.

A radio interferometer for the observation of radio sources of small angular dimensions and relatively rapid variation of intensity with time is described, in which the source is constantly scanned by the interference pattern. The system can also be used for recording polarization and the variation of polarization with time.
R.C.Glass

523.164

12947. A NEW HIGH RESOLUTION [RADIO] INTERFEROMETER FOR SOLAR STUDIES. M.R.Kundu.
J. Instn. Telecomm. Engrs (New Delhi), Vol. 5, No. 2, 77-85 (March, 1959).

A description of an instrument operating at a wavelength of 3cm. By tracking the source across the sky with the two elements of the interferometer, it is possible to explore different regions of the Fourier spectra of the angular brightness distribution without the necessity of displacing the aerials. The application of the system to the study of the evolution in intensity and dimension of the various sources of solar radiation is discussed. C.Hazard

523.164

12948. THE ANGULAR SIZE OF SHORT-LIVED SOLAR RADIO DISTURBANCES. S.J.Goldstein, Jr.
Astrophys. J., Vol. 130, No. 2, 393-9 (Sept., 1959).

A wide-band two-element adding interferometer which accepts simultaneously the radiation in the range 105-140 Mc/s was used to observe short-lived solar disturbances. The angular size of type I bursts was found to be less than 1.6 min of arc. The average angular size of type III bursts in three clusters was 3.2 min, and for four other clusters an average lower limit of 3.3 min was obtained. The theory of these measurements is explained.

523.164.3

12949. RADIO-FREQUENCY OBSERVATIONS OF THE PLANETS IN 1957-1958. A.G.Smith and T.D.Carr.
Astrophys. J., Vol. 130, No. 2, 641-7 (Sept., 1959).

Analysis of all the available observations during the 1957-1958 opparition, indicates that the Jupiter radio sources continue to rotate with a uniform period of $9^h55^m28^s.8$. Measurements of the polarization of the radiation seem to confirm the existence of a Jovian magnetic field. Radio observations of Venus and Uranus have given negative results, whereas there is some evidence of sporadic radiation from Saturn.

523.164.32

12950. POSSIBLE MECHANISMS OF SPORADIC SOLAR RADIO EMISSION (RADIATION IN ISOTROPIC PLASMA).
V.L.Ginzburg and V.V.Zheleznyakov.
Astron. Zh., Vol. 35, No. 5, 694-712 (1958). In Russian.

The coherent and incoherent mechanisms of sporadic emission in an isotropic coronal plasma are discussed. It is shown that it is impossible to connect type-II bursts with an incoherent plasma mechanism of radio emission. A preliminary examination of reabsorption and of the conditions for the transition of plasma waves into electromagnetic radiation shows that the incoherent mechanism cannot be used also for explaining type-III bursts. However, this latter possibility cannot be completely excluded. The coherent plasma mechanism allows for the interpretation of the peculiarities of type-III bursts and, in all probability, of type-II bursts. It is impossible to limit the examination of high-level radio emission and type-I bursts related to sunspots, because of polarization, by considering only isotropic plasma.

523.164.4

12951. ESTIMATES OF THE TOTAL ENERGY IN PARTICLES AND MAGNETIC FIELD IN THE NON-THERMAL RADIO SOURCES.
G.R.Burbidge.
Astrophys. J., Vol. 129, No. 3, 849-52 (May, 1959).

On the assumption that the synchrotron mechanism is responsible for emission from radio sources, estimates of their total energy can be made if certain optical and radio information is available. The magnetic field is estimated from the known volume of the source and the assumption of energy equipartition. Values of the magnetic field and the total energy, assuming either an electron —positron flux or a proton flux 100 times greater, were estimated for five galactic sources and 14 extragalactic objects.
R.D.Davies

523.2

12952. THE MOTION AROUND THE SUN OF A PLANET OF RELATIVISTIC ENERGY SUBJECT TO A GENERALIZED FORCE OF ATTRACTION. ADVANCE OF THE PERIHELION. T.Zeuli.
Atti Accad. Sci. Torino 1, Vol. 93, No. 1, 84-94 (1958-59). In Italian.

The generalized gravitational potential is taken to be

$$\frac{m_0\mu}{rc^2}\left(c^2 + \frac{\alpha\mu}{r} + \beta r^2 + \gamma v^2\right)$$

The relativistic perihelion advance follows in the first approximation if the constants α, β, γ are such that $\alpha + \beta + 2\gamma = 5/2$.
R.A.Newing

523.35

12953. EFFECT OF THE SOLAR WIND ON THE LUNAR ATMOSPHERE. J.R.Herring and A.L.Licht.
Science, Vol. 130, 266 (July 31, 1959).

The extent of the lunar atmosphere is severely limited by collision with the protons of the solar wind.

523.4

12954. THE DISSIPATION OF GAS FROM PLANETARY ATMOSPHERES. II. THE TOTAL VELOCITY OF DISSIPATION OF GAS FROM A PLANETARY ATMOSPHERE. THE PROBLEM OF TERRESTRIAL HELIUM. É.K.Byutner.
Astron. Zh., Vol. 36, No. 1, 89-99 (1959). In Russian.

For Pt I, see Astron. Zh., Vol. 35, No. 4, 572 (1958). A general expression is given for the velocity of gas dissipation from which the Lennard-Jones formulae follow as limiting cases. (There is a difference of a constant in the case of a rarefied gas.) This velocity, and the thickness and position of the layer where the dissipating process is most effective, are calculated for the two cases of a single component atmosphere and an atmosphere consisting of a heavy gas and a small admixture of a light one. In the second case the thickness is much less than in the first, and in both it increases with the kinetic energy of the gas. The position of the layer of maximum intensity of dissipation is found. The results are applied to the dissipation of helium from the earth's atmosphere at the present time.
G.A.Chisnall

523.4 : 551.510.4

12955. ON THE DISSIPATION OF HYDROGEN FROM PLANETARY ATMOSPHERES. É.K.Byutner.
Dokl. Akad. Nauk SSSR, Vol. 124, No. 1, 53-6 (1959). In Russian.

Photodissociation of water occurs mainly in a layer of the earth's atmosphere between 70 and 80 km and is due to radiation in the interval 1860-1760 A; the associated probabilities are 3×10^{-8} sec^{-1} at 70 km and 4×10^{-7} sec^{-1} at 80 km. The speed of dissipation of terrestrial hydrogen is estimated at 10^9 cm^{-2} sec^{-1}. The amount of oxygen in the atmosphere of Mars is found to be one thousandth of that in the earth's atmosphere, in agreement with the spectroscopic value. G.A.Chisnall

523.4 : 551.521.14

DIFFUSE REFLECTION FROM PLANETARY ATMOSPHERES. See Abstr. 12899

523.57

12956. PHOTOMETRIC ANALYSIS OF A SPECTROGRAM OF A VERY SLOW METEOR. P.M.Millman and A.F.Cook.
Astrophys. J., Vol. 130, No. 2, 648-62 (Sept., 1959).

The spectrum of a very slow meteor photographed from the Meanook Meteor Observatory on October 20, 1952, was measured photometrically. Comparison is made, for line identifications only, with a spectrogram obtained by the Harvard Meteor Expedition at Soledad Canyon on July 6, 1953. A direct photograph of the 1952 meteor was secured at the Newbrook Meteor Observatory, whence a complete triangulation and reduction for height, velocity, and deceleration was made by Jacchia at Harvard College Observatory. The light-curve of the meteor was determined,and its observed physical parameters are discussed. The principal results of the photometric analysis are a profile of the continuum in absolute units at wavelengths longer than 4800 A, believed due to the first positive group of nitrogen bands, and a continuous increase in brightness of these bands relative to the brightness of the meteor along the trail.

523.743

12957. PHOTOGRAPHS OF THE SOLAR GRANULATION TAKEN FROM THE STRATOSPHERE. M.Schwarzschild.
Astrophys. J., Vol. 130, No. 2, 345-63 (Sept., 1959).

A 12 in. solar telescope equipped with a photoelectric pointing mechanism and an automatic camera was flown by unmanned balloons to an altitude of 80 000 ft. A number of photographs of the solar granulation obtained with this telescope are of very high definition and show the granulation to have the character of non-stationary convection. The bright granules, ranging in diameter from about 300 to about 1800 km, are of highly irregular, often polygonal, shape and are separated from one another by dark, often very narrow, lanes. The r.m.s. temperature fluctuation, uncorrected for instrumental smoothing, is found to be only $\pm 60^0$. The analysis suggests that the true r.m.s. temperature fluctuation is probably not larger than $\pm 100^0$.

523.75 : 550.385

SOLAR FLARES AND GEOMAGNETIC STORMS. See Abstr. 12889

523.75 : 537.591.15

SOLAR FLARE OF MAY 10, 1959 AND INCREASE IN COSMIC RAYS. See Abstr. 13407

523.755

12958. COLLISIONAL IONIZATION CROSS-SECTION FOR Fe XIV IN THE SOLAR CORONA AND THE CORONAL ELECTRON TEMPERATURE. S.B.Schwartz and H.Zirin.
Astrophys. J., Vol. 130, No. 2, 384-92 (Sept., 1959).

A new calculation of the ionization cross-section of Fe XIV by electron collision is given, using a hydrogen-like model where all continuum wave-functions approach Coulomb functions at large distances from the atom. The resulting cross-section is more than a factor of 10 smaller than the values in current use and, when inserted in the coronal ionization formula, gives an electron kinetic temperature of about 2×10^6 degrees for a green to red line-intensity ratio of unity.

523.76

12959. THE SUN'S POLAR MAGNETIC FIELD. H.D.Babcock.
Astrophys. J., Vol. 130, No. 2, 364-5 (Sept., 1959).

The polarity of the high-latitude dipolar magnetic field of the sun was opposite to that of the earth's field from 1953 to 1957. About the middle of 1957, the polarity of the magnetic field near the south heliographic pole was reversed; reversal of the field near the north pole was not observed until November, 1958. At present, the sun's polar field is parallel to that of the earth.

523.76

12960. OBSERVATIONS OF SOLAR MAGNETIC FIELDS IN PLAGE REGIONS. R.B.Leighton.
Astrophys. J., Vol. 130, No. 2, 366-80 (Sept., 1959).

A new method of mapping the solar magnetic field is described, and preliminary results are presented. Relatively strong fields, up to 100 or 200 gauss in strength are found in extensive areas throughout plage regions, the field pattern being in striking agreement with the pattern of Ca II emission. A plausible mechanism of excitation of the Ca^+ ions is described, and some possible consequences of this mechanism are briefly discussed.

523.77

12961. THE DOUBLE REVERSAL IN THE CORES OF THE FRAUNHOFER H AND K LINES.
L.Goldberg, O.C.Mohler and E.A.Müller.
Astrophys. J., Vol. 129, No. 1, 119-33 (Jan., 1959).

Observations are presented of the profiles of the central doubly reversed cores of the H and K lines of Ca II. The profiles were obtained photoelectrically with the vacuum spectrograph of the McMath-Hulbert Observatory at five different points on the solar disk from $\mu = 1.0$ to $\mu = 0.2$. At the centre of the disk the central intensities of H and K are 2.95 and 2.36%, respectively, in terms of the neighbouring continuous spectrum near $\lambda 4000$. At $\mu = 0.2$ the central intensities are 2.41 and 2.01% for H and K, respectively, als with reference to the continuum at $\lambda 4000$ at the centre of the disk. The relative intensity ratio H:K is found to be constant in the inner absorption core and nearly the same for all values of μ. This suggests that the logarithm of the source function varies linearly with the logarithm of N_h, the number of Ca II atoms per square centimetre above height, h, in the chromosphere. The Doppler widths were derived by two methods: (1) by an intercomparison method which is independent of the source function; (2) by using the depth-dependence of the source function and the shapes of the profiles. The Doppler widths thus found increase from 0.063 A at $\mu = 1.0$ to 0.110 A at $\mu = 0.2$. The derived Doppler widths and sourc function are employed to calculate the profiles of the inner cores of H and K. Extremely good agreement is found between the calculate and the observed central cores at all five values of μ. The variatio in the Doppler widths from centre to limb is discussed, and it is concluded that the widening of the profiles to the limb is caused by an increase in turbulence with height, combined with anisotropy. The comparison of the Doppler widths derived for Ca II with result previously obtained for the $\lambda 10830$ line of He I supports the hypothesis that the chromosphere is heterogeneous and is composed of regions of quite different physical properties.

523.77

12962. EMISSION-LINE INTENSITIES IN THE SOLAR ULTRAVIOLET. A.Aboud, W.E.Behring and W.A.Rense.
Astrophys. J., Vol. 130, No. 2, 381-3 (Sept., 1959).

Intensities of 24 solar ultraviolet emission lines in the range 1206-1817 A were computed from a photometric analysis of rocket spectrograms obtained on August 6, 1957. HLα (1215.7 A) and two lines of Si II (1808.0 and 1816.9 A) were the most intense, measurin 3.43, 1.05, and 1.65 ergs/cm^2/sec, respectively, at heights between 130 and 150 km. The He II line at 1215.1 A appears to be present o the wing of HLα. The half-width of HLα was fixed at between 0.7 and 0.8 A. Ultraviolet continuum intensities were estimated at two wavelengths.

523.7

12963. CH IN THE SOLAR SPECTRUM.
C.E.Moore and H.P.Broida.
J. Res. Nat. Bur. Stand., Vol. 63A, No. 1, 19-53 (July-Aug., 1959).

CH lines in the solar spectrum have been identified by direct comparison of measured laboratory and solar wavelengths and intensities. The comparisons of individual rotational lines are included in a series of tables arranged according to electronic and vibrational transitions.

523.8

12964. THE CHROMATIC SCINTILLATION OF STARS.
V.I.Tatarskii and L.N.Zhukova.
Dokl. Akad. Nauk SSSR, Vol. 124, No. 3, 567-70 (1959). In Russian

A theoretical discussion, including the derivation of the corre

tion coefficient between the fluctuations of amplitude of two plane rallel monochromatic waves of given wavelengths. Independent perimental results are compared and satisfactory agreement is tained with the theoretical curve. This supports the view that minishing scintillation in integrated light with increasing zenith stance can be explained by chromatic scintillations.

G.A.Chisnall

523.85

2965. TILT CRITERIA AND DIRECTION OF ROTATION OF PIRAL GALAXIES. G.de Vaucouleurs.
strophys. J., Vol. 127, No. 2, 487-503 (March, 1958).

Presents a review of the observational evidence on the direction f rotation of the spiral pattern in ordinary and barred spirals. The easons for the divergences in the interpretation of various objects ccording to the classical (Slipher–Hubble) viewpoint, and according the Stockholm school, are analysed. A list of critical objects is ssembled which permits an unequivocal solution of the ambiguities rom a variety of criteria, both classical and new, applied to struc- ural details visible on the best Wilson–Palomar photographs, sup- lemented by new Lick spectra. In all cases, where the required ata are available, these criteria indicate that the arms are trailing the rotation.

523.855 : 539.17

2966. NUCLEAR REACTIONS IN COLLISIONS OF GALAXIES. .N.Milford.
strophys. J., Vol. 130, No. 2, 465-8 (Sept., 1959).

When two galaxies collide, the interaction of their interstellar ases causes nuclear reactions to occur. Order-of-magnitude cal- ulations show that the effect of these reactions is negligible during he early stages of the collision. However, if a sufficiently com- ressed gas develops in the later stages of the collision, the calcu- tions show that discrete gamma radiation from the collision should e observable above the earth's atmosphere.

523.872

2967. THE CALCULATION OF OPACITIES FOR STELLAR NTERIORS. H.Zirin.
strophys. J., Vol. 128, No. 2, 342-7 (Sept., 1958).

A simplified method is given by means of a sample case. A able of opacities for various temperatures and densities is given or four mixtures.

523.872

2968. AN INVESTIGATION OF THE RELATION BETWEEN OLOUR EXCESS AND THE FACTOR FOR CONVERTING SELEC- IVE ABSORPTION INTO TOTAL ABSORPTION. I. .F.Torondzhadze.
stron. Zh., Vol. 35, No. 1, 71-81 (1958). In Russian. English trans- tion in: Soviet Astron. - AJ (New York), Vol. 2, No. 1, 60-9 Jan.-Feb., 1958).

The theoretical expression for the factor γ, used to convert elective absorption into total absorption, is analysed. The calc- lation of the limiting values of this factor shows that γ depends on he optical path of light in absorbing matter. Formulae for the total bsorption, the colour excess, and γ, have been derived, taking into ccount second-order terms. It is shown that for a complete charac- erization of the photometric system it is not sufficient to determine nly the effective wavelengths. It is also necessary to take into ccount parameters which characterize the transmission width of he system. The mean square of the absorption coefficient may serve s such a parameter.

523.877

2969. MAGNETIC FIELDS OF THE A-TYPE STARS. .W.Babcock.
strophys. J., Vol. 128, No. 2, 228-58 (Sept., 1958).

A discussion of rotational line broadening in the spectra of -type stars tends to confirm the view that strong coherent agnetic fields are a property of all rapid rotators having con- ective zones but that fields are observable only in the small prop- rtion of such stars that happen to be observed nearly pole-on. he A stars with observable fields are classed as α-variables showing periodic magnetic variations); β-variables (irregular agnetic variations with reversal of polarity); γ-variables (irregular agnetic fluctuations without reversal of polarity); and δ-variables rratic spectrum variables with irregular magnetic variations). ll groups have "peculiar" spectra (abundance anomalies), undoubt- dly arising from magnetic activity. The irregular magnetic fluc- tuations must occur through intrinsic magnetohydrodynamic motions of the stellar material that carries the magnetic lines of force. Irregular atmospheric mixing in the β- and γ-groups results in peculiar spectra but relatively invariant line intensities; a higher degree of organization in the magnetically periodic α-variables results in peculiar spectra with synchronous variations in line intensity. A basic physical process must underlie the extraordinary properties of the typical α-variables: they show large-amplitude, nearly symmetric magnetic reversals in periods ranging from 4 to 9 days; they display selective variations in line intensity, as well as the cross-over effect and variations in luminosity. The proposal is made that this process is a vastly amplified and accelerated magnetohydrodynamic oscillation analogous to the 22-year solar magnetic cycle. An alternative model, the oblique rotator, is also discussed.

523.877

12970. THE INFLUENCE OF INTERSTELLAR REDDENING ON THE CONTRIBUTION OF THE BALMER LINES TO PHOTO-ELECTRIC MAGNITUDES. A.M.Rozis-Saulgeot.
C.R. Acad. Sci. (Paris), Vol. 249, No. 1, 42-3 (July 6, 1959). In French.

For stars of type-A, the contribution of the Balmer absorption lines to the standard p.e. magnitudes U and B on the U,B,V system is found to vary linearly with the observed amount of interstellar reddening. Given values of the reddening between 0 (zero) and 1 (max.) on an empirical opacity scale, the measured quantity Δ(U-B) (Abstr. 7748 of 1959) varies between 0.17 and 0.35 mag.

D.R.Barber

523.877

12971. ATOMIC AND MOLECULAR NEGATIVE IONS IN STELLAR ATMOSPHERES. L.M.Branscomb and B.E.J.Pagel.
Monthly Nat. Roy. Astron. Soc., Vol. 118, No. 3, 258-70 (1958).

Late-type stars show continuous absorption from other sources besides the H^- ion. These sources begin to appear in the sun, and increase in strength towards later spectral types, especially in carbon stars. On the basis of recent theoretical and laboratory work on atomic and molecular negative ions, the concentrations of C^-, O^-, OH^- and CN^- are roughly calculated in giants and dwarfs of various compositions and their contributions to the continuous absorption coefficient assessed. O^- is generally unimportant; C^- is likely to be important in stars with very high C_2 abundance such as R Cr B; OH^- may be important in the late M and S stars; and CN^- perhaps contributes more than C_3 to the violet absorption in late N stars.

523.877 : 534.222.2

SHOCK WAVES IN A GRAVITATING GAS UNDER ZERO TEMPERATURE GRADIENT. See Abstr. 13094

523.877 : 539.17

CARBON THERMONUCLEAR REACTIONS IN THE STARS. See Abstr. 13711

525.3

12972. NOTE ON R.R.NEWTON'S PAPER, "MOTION OF A SATELLITE AROUND AN UNSYMMETRICAL CENTRAL BODY." T.E.Sterne.
J. appl. Phys., Vol. 30, No. 2, 270 (Feb., 1959).

The surprising conclusions of Newton's paper are removed when a more reasonable representation of the lunar gravitational field is adopted. See Abstr. 6471 (1959). G.A.Chisnall

525.3

12973. NEW APPROACH IN THE THEORY OF SATELLITE ORBITS. J.P.Vinti.
Phys. Rev. Letters, Vol. 3, No. 1, 8 (July 1, 1959).

The author indicates that a choice of a suitable potential (whose even harmonics in the oblate spheroidal coordinates are exact to the second and whose fourth harmonic is comparable with empirical values), reduces the problem of investigating the motion of an earth satellite to quadratures. J.K.Skwirzynski

525.3

12974. SHORT-TIME MEASUREMENT OF TIME DILATION IN AN EARTH SATELLITE. R.S.Badessa, R.L.Kent and J.C.Nowell.
Phys. Rev. Letters, Vol. 3, No. 2, 79-80 (July 15, 1959).

The authors propose a feasible method for measuring gravitational red shift, postulated by Einstein's general theory of relativity. The method involves comparison of the times kept by a stable clock

on a satellite and an identical one on the ground, over a short time (30 sec or less), and is independent of the first order Doppler effect. J.K.Skwirzynski

525.3 : 535.39 : 536.
TEMPERATURE STABILIZATION OF HIGHLY REFLECTING SPHERICAL SATELLITES. See Abstr. 13216

PHYSICS

GENERAL

530.1

12975. PHYSICS FOR THE FIRST GRADE. R.J.Seeger.
Amer. J. Phys., Vol. 27, No. 7, 494-500 (Oct., 1959).

This paper deals with a proposed programme for the education of the citizen in science, which would start at the kindergarten level. It deals particularly with the writer's occasional experiences in teaching physics in grades one through five. In the first three grades, particular attention has been paid to the combination of physics with arithmetic. The paper concludes with several suggested principles for curricula construction: genetic selection, cultural integration, and wholesome meaning.

530.1

12976. PHYSICS LABORATORY ADMINISTRATION AND OPERATION. M.W.P.Strandberg.
Amer. J. Phys., Vol. 27, No. 7, 503-7 (Oct., 1959).

Laboratory instruction in undergraduate courses allows the student to encounter physical problems in association with physicists. The value of this experience does not derive from the experiments per se, but the administration and operation of the laboratory may be arranged to optimize its educational value.

GRAVITATION . RELATIVITY

530.12

12977. GRAVITATIONAL FIELD OF A POINT CHARGE. J.Callaway.
Amer. J. Phys., Vol. 27, No. 7, 469-70 (Oct., 1959).

A semiclassical derivation of the gravitational potential of a point charge is given. The result agrees with the general theory of relativity except for a factor of $\frac{1}{2}$, which arises as a consequence of the vanishing of the trace of the electromagnetic stress–energy tensor.

530.12

12978. MOTION OF FREE PARTICLES IN DISCONTINUOUS GRAVITATIONAL FIELDS. C.Møller.
Amer. J. Phys., Vol. 27, No. 7, 491-3 (Oct., 1959).

A new paradox occurring in the usual solution of the original "clock paradox" is given a natural physical interpretation by the observation that the mass of a particle moving in a gravitational potential as well as on the velocity, thus changing abruptly when a gravitational field is suddenly turned off.

530.12

12979. GRAVITATIONAL RADIATION ACCORDING TO BEL. D.Geissler.
Z. Naturforsch., Vol. 14a, No. 8, 696-8 (Aug., 1959). In German.

Bel's analogues of the Maxwell tensor, Poynting vector and energy density are evaluated for the previously considered case of a temporarily non-stationary system. The radiation criterion of a non-zero "Poynting" vector is shown to be satisfied for this system, but attention is drawn to difficulties arising in a direct physical interpretation of Bel's analogues. R.A.Newing

530.12

12980. CONSERVATION IDENTITIES IN UNIFIED FIELD THEORY. M.Lenoir.
C.R. Acad. Sci. (Paris), Vol. 249, No. 1, 44-6 (July 6, 1959). In French.

On the basis of a generalization of the Einstein–Schrödinger unified theory (Abstr. 7755 of 1959), the Bianchi identities are derived and the conservation identities obtained by the method of Mavrides. The results are applied to the theory of Bonnor T.R.Carso

530.1

12981. ON THE MECHANICAL FOUNDATION OF THE THEORY OF SPECIAL RELATIVITY. K.Stiegler.
Nuovo Cimento, Vol. 13, No. 5, 873-9 (Sept. 1, 1959).

From the given system of five axioms expressing the mechanical aspect of physical reality there follow the well-known expressions for the mass and the energy of material particles, the existence of the limit velocity for them and its independency from the relative velocity of the Galilean systems of reference, further Einstein's law of the addition of velocities and the Lorentz–Einste transformation. Finally it is shown briefly that Newton's "tempus absolutum verum et mathematicum" is mutually conditioned with the constant mass of material particles and vice versa.

530.1

12982. EINSTEIN'S FIELD EQUATIONS. S.D.Majumdar.
Nuovo Cimento, Vol. 13, No. 5, 880-90 (Sept. 1, 1959).

The nature of a static line element in relativity theory is investigated and it is shown that both the force and the torque on an isolated body must vanish if the field equations for empty space are to have a static solution in its neighbourhood. It is also shown how a general solution for a static electro-gravitational field can be constructed by a method of successive approximation.

530.12 : 538.

12983. STRUCTURE OF THE ELECTROMAGNETIC FIELD. B.Bertotti.
Phys. Rev., Vol. 115, No. 3, 742-5 (Aug. 1, 1959).

The structure of a curved space-time in which a source-free electromagnetic field is present is studied according to the "alread unified field theory" of Misner and Wheeler (Abstr. 1468 of 1958), and the geometrical meaning of the differential conditions imposed on the Ricci tensor is established. Four independent equations equivalent to the algebraic conditions are stated, and the case of a null electromagnetic field is also clarified.

530.12 : 538

12984. VARIATIONAL PRINCIPLE FOR GEOMETRODYNAMICS. D.Sharp.
Phys. Rev. Letters, Vol. 3, No. 2, 108-10 (July 15, 1959).

A variational principle for geometrodynamics is proposed, fro which certain of the field equations can be derived. The problem o obtaining the remaining field equations is related to the problem of finding a superpotential for the metric tensor, and thus to validate a variational principle which summarizes in purely geometrical terms the whole content of classical source-free electromagnetism and general relativity. T.R.Carso

530.1

12985. THE "ASTRONOMICAL" MOTION PROBLEM IN THE GENERAL THEORY OF RELATIVITY. D.Geissler.
Z.Naturforsch., Vol. 14a, No. 8, 689-96 (Aug., 1959). In German.

Equations of motion for bodies moving in their gravitational field are derived to the first order in the gravitational constant κ. The equations, which are valid for weak fields but are not restricte to slowly moving bodies, are integrated for the hyperbolic case of the two-body problem. R.A.Newir

530.1

12986. NOTE ON STRESS EFFECTS DUE TO RELATIVISTIC CONTRACTION. E.Dewan and M.Beran.
Amer. J. Phys., Vol. 27, No. 7, 517-18 (Oct., 1959).

In this note a thought experiment is used to show that relativis contraction can introduce stress effects in a moving body.

530.12 : 534.222.2

CONDITIONS FOR SHOCK WAVES ACCORDING TO THE ENERAL THEORY OF RELATIVITY. See Abstr. 11931

530.12 : 535.13

COVARIANT GENERALIZATION OF THE STOKES PARA-ETERS. See Abstr. 11988

FIELD THEORY . QUANTUM THEORY

530.145 : 530.12

12987. A GENERALLY RELATIVISTIC FIELD THEORY. .Fronsdal.
uovo Cimento, Vol. 13, No. 5, 988-1006 (Sept. 1, 1959).

In an effort to make contact between field theory and general lativity it is suggested to study space-times embeddable in flat paces of higher dimensions, as intermediate steps between special nd general relativity. The Lorentz invariant action principle rmulation of single particle field theory is found to possess a very itural and simple extension to space-times embeddable in a flat x-space. Viewing space-time as a 4-surface in six-space, the etric properties of the former are determined by requiring the tion to be stationary with respect to variations of the 4-surface. more definite theory is obtained by imposing some rather severe strictions on the form of the Lagrangian. A simple example is udied in detail and is found to describe a pair of Dirac fields teracting through the gravitational field. The main virtue of the eory is that it takes into account the mutual interaction between atter and metric in a consistent manner. It seems plausible that ach's principle is contained. Second quantization is not carried out, it may be fairly simple by Schwinger's method.

530.145 : 530.12

12988. GROUP-THEORETICAL TREATMENT OF THE OUNDATIONS OF RELATIVISTIC QUANTUM MECHANICS. . IRREDUCIBLE REPRESENTATIONS. Yu.M.Shirokov.
h. eksper. teor. Fiz., Vol. 36, No. 3, 879-88 (1959). In Russian.

For Pt.IV, see Abstr. 7713 (1958). It is shown that the concept f time parity cannot be introduced for particles with a nonvanishing est mass; for particles with a nonvanishing rest mass two quivalent concepts which differ in respect to space-time parity roperties exist for a given spin. With aid of the concept of a niversal covering group it is shown that for particles with half-nteger spins the number of possible representations with various eflection laws is larger than has hitherto been assumed.

530.145

12989. TIME IN QUANTUM MECHANICS. .Engelmann and E.Fick.
Nuovo Cimento Suppl., Vol. 12, No. 1, 63-72 (1959). In German.

Using a Hermitean operator corresponding to the time, a ormulation of the equations of motion which is independent of the icture (Heisenberg or Schrödinger) is presented.

W.A.Hepner

530.145

12990. NON-CONSERVATION OF PARITY IN THE FIRST ORDER OF THE WEAK-INTERACTION COUPLING CONSTANT IN ELEC-TRON SCATTERING AND IN OTHER EFFECTS. Ya.B.Zel'dovich.
Zh. eksper. teor. Fiz., Vol. 36, No. 3, 964-6 (1959). In Russian.

By symmetry arguments, the existence of the interaction

$$g\,(\bar{p}\,O\,p)(\bar{e}^{-}\,O\,e^{-}) + \text{h.c.}$$

s assumed, where $O = \gamma_\mu(1 + i\gamma_5)$. As a consequence of this, one night expect a difference of the order of 0.1-0.01% in the scattering ross-section of fast right- and left-polarized electrons on unpolar-zed nuclei. Similarly, the above interaction will lead to a level-hift of electron energy-levels of different parities in a free atom, vhich will manifest itself in a very small optical activity of any rbitrary material. P.Roman

530.145

12991. SPECTRAL CONDITION AS A MEANS OF RENORMAL-IZATION. B.V.Medvedev and M.K.Polivanov.
Dokl. Akad. Nauk SSSR, Vol. 127, No. 3, 537-40 (July 21, 1959). In Russian.

The spectral representation of a particle as an asymptotic sum of "principal terms" is discussed and its equivalence with the integral representation is shown to lead to a renormalization condition. The condition is then applied to the mass and charge renormalization of the V-particle using Lee's model for the Green's function (Abstr. 9936 of 1954) and a functional integration procedure.

J.W.Gardner

530.145

12992. ON THE POSSIBILITY OF ENERGY DEPENDING SYMMETRY PROPERTIES. B.Ferretti.
Nuovo Cimento, Vol. 13, No. 2, 456-7 (July 16, 1959).

A theorem is stated which, under certain conditions, eliminates the possibility that there are symmetry properties which are rigorous at certain energies but break down at others. The conditions are: (1) that the interactions are local and (2) that if there are states in which the symmetry property concerned is valid it is always possible to perturb these states with a small external interaction which commutes with this symmetry property. The latter property is necessary if the symmetry property concerned is to have any significance in actual physical situations. E.J.Squires

530.145

12993. ANTICOMMUTATOR FOR A NONLINEAR FIELD THEORY. F.L.Scarf.
Phys. Rev., Vol. 115, No. 2, 463-7 (July 15, 1959).

The anticommutator for the Thirring model is computed by ordering the operator $\psi(x)\psi^*(x')$ and evaluating its renormalized vacuum expectation value. The infrared divergence is defined by introducing an ad hoc cutoff. The final expression does not agree with the approximations obtained by using perturbation theory or by using expansion over intermediate states (with the same cutoff). It is also found that Heisenberg's procedures cannot be applied to this two-dimensional problem.

530.145

12994. HAAG'S THEOREM AND CLOTHED OPERATORS. O.W.Greenberg.
Phys. Rev., Vol. 115, No. 3, 706-10 (Aug. 1, 1959).

Haag's theorem (Abstr. 5864 of 1955) is proved. This theorem states — essentially — that a given relativistic field which, at a fixed time, is related by a unitary transformation to the free field, is completely equivalent to the free field throughout all space-time. Previously it had been proved that the vacuum expectation values of the given field equal the free-field ones up to and including the four-fold vacuum expectation value. A corollary to Haag's theorem is derived. The corollary shows that a certain type of relativistic clothed operator is equivalent to the free field everywhere.

530.145

12995. DISPERSION RELATION FOR NONLINEAR VACUUM POLARIZATION EFFECTS. J.G.Gilson.
Phys. Rev., Vol. 115, No. 3, 752-4 (Aug. 1, 1959).

The current induced in the vacuum by an external field is a nonlinear functional of the latter when one goes beyond the first approximation. It is demonstrated that when this induced current is suitably defined it will satisfy the causality requirement of being zero before the external field is switched on. From this causality principle an exact dispersion relation is deduced. This relaxation of the linearity restriction in deriving a dispersion relation from causality implies that it may be possible to drop the linearity restriction in discussing the equivalence of causality and dispersion relations for other systems.

530.145

12996. RADIATION FROM A POLARIZED RADIATING ELECTRON. I.M.Ternov and V.S.Tumanov.
Dokl. Akad. Nauk SSSR, Vol. 124, No. 5, 1038-41 (1959). In Russian.

An electron moving in a constant homogeneous magnetic field is postulated. The four components of the Dirac wave-function for such an electron are written out for a given spin orientation corresponding to the polarization, and are employed to formulate the radiation emission amplitudes and angular distributions.

J.W.Gardner

530.145

12997. SIGNIFICANCE OF ELECTROMAGNETIC POTENTIALS IN THE QUANTUM THEORY. Y.Aharonov and D.Bohm.
Phys. Rev., Vol. 115, No. 3, 485-91 (Aug. 1, 1959).

Some interesting properties of the electromagnetic potentials in the quantum domain are discussed. It is shown that, contrary to

the conclusions of classical mechanics, there exist effects of potentials on charged particles, even in the region where all the fields (and therefore the forces on the particles) vanish. Possible experiments to test these conclusions are discussed, and, finally, further possible developments in the interpretation of the potentials are suggested.

530.145

12998. EUCLIDEAN QUANTUM ELECTRODYNAMICS.
J.Schwinger.
Phys. Rev., Vol. 115, No. 3, 721-31 (Aug. 1, 1959).

Quantum electrodynamics is transcribed into a Euclidean metric. A review is presented of the quantum action-principle approach to quantization, with its automatic emphasis on the dynamical variables associated with the physical degrees of freedom. Green's functions of the radiation gauge are defined, and then characterized by differential equations and boundary conditions. These Green's functions are of direct physical significance but involve a distinguished time-like direction. A gauge transformation is then performed to eliminate this dependence, introducing thereby the Green's functions of the Lorentz gauge, which lack immediate physical interpretation. The latter functions are now primarily defined by differential equations and boundary conditions, and form the basis for the analytic extension which is the change from space-time to Euclidean metric. Some properties of anticommuting matrices are discussed in relation to this metric transformation. Real Euclidean Green's functions are defined by correspondence with the Lorentz gauge functions and the appropriate differential equations obtained. Invariance properties of the Euclidean functions are discussed. The individual Euclidean Green's functions are given an operator construction and then combined into a generating Green's functional which is interpreted as the wave function, in a canonical field representation, of a state characterized by the Euclidean action operator. Differential operator realizations and some other benefits of a canonical variable description are exhibited.

530.145

12999. "LATENT STRUCTURE" IN THE LEE MODEL.
E.V.Teodorovich.
Dokl. Akad. Nauk SSSR, Vol. 126, No.6, 1236-8 (June 21, 1959). In Russian.

The interaction Hamiltonian for the particle model proposed by Lee (Abstr. 9936 of 1954) is evaluated in an arbitrary (Lorentz-invariant) field. The "latent structure" of the model is shown to give rise to interaction terms which may be identified with the "dipole-ghosts" required by Heisenberg's unitary theory. (Abstr. 2691 of 1956; 4734 of 1958). J.W.Gardner

530.145

13000. FURTHER DEVELOPMENTS OF THE COVARIANT FUNCTIONAL FORMALISM FOR INTERACTING FIELDS.
R.S.Liotta.
Nuovo Cimento, Vol. 13, No. 5, 921-35 (Sept. 1, 1959).

The covariant functional formalism developed in Pt I and II (Abstr. 6622 of 1958) is extended to the case of coupled boson fields. The sufficiency of the knowledge of the energy in order to determine the evolution of coupled fields is discussed, and some properties of the state vector, resulting immediately from the covariant functional formulation in the Schrödinger representation, are given. It is shown that at the classical limit ($\hbar \to 0$), the solution of the equations of motion for coupled fields exists and is unique.

530.145 : 539.165

13001. LEPTON CONSERVATION AND TIME REVERSAL IN β-DECAY. H.Schopper and H.Müller.
Nuovo Cimento, Vol. 13, No. 5, 1026-34 (Sept., 1959).

It was investigated which conclusions can be inferred from β-decay experiments taking into account experimental errors but without making theoretical assumptions.

530.145

13002. SET OF COORDINATE SYSTEMS WHICH DIAGONALIZE THE KINETIC ENERGY OF RELATIVE MOTION.
D.W.Jepsen and J.O.Hirschfelder.
Proc. Nat. Acad. Sci. U.S.A., Vol. 45, No. 2, 249-56 (Feb., 1959).

These systems give, for the N-particle system, a Schrodinger equation without cross derivatives. They are constructed on the same principles as a 'mobile'. J.C.Taylor

530.14

13003. A NON-LINEAR THEORY OF STRONG INTERACTIONS.
T.H.R.Skyrme.
Proc. Roy. Soc. A, Vol. 247, 260-78 (Sept. 16, 1958).

A non-linear theory of mesons, nucleons and hyperons is proposed. The three independent fields of the usual symmetrical pseudoscalar pion field are replaced by the three directions of a four-component field vector of constant length, conceived in an Euclidean four-dimensional isotopic spin space. This length provides the universal scaling factor, all other constants being dimensionless; the mass of the meson field is generated by a ϕ^4 term; this destroys the continuous rotation group in the iso-space, leaving a "cubic" symmetry group. Classification of states by this group introduces quantum numbers corresponding to isotopic spin and to "strangeness"; one consequence is that, at least in elementary interactions, charge is only conserved modulo 4. Furthermore, particle states have not a well-defined parity, but parity is effectively conserved for meson-nucleon interactions. A simplified model, using only two dimensions of space and iso-space, is considered further; the non-linear meson field has solutions with particle character, and an indication is given of the way in which the particle field variables might be introduced as collective co-ordinates describing the dynamics of these particular solutions of the meson field equations, suggesting a unified theory based on the meson field alone.

530.14

13004. SOME CONSEQUENCES OF SYMMETRIES OF THE STRONG INTERACTIONS. G.Feinberg and R.E.Behrends.
Phys. Rev., Vol. 115, No. 3, 745-9 (Aug. 1, 1959).

The consequences for the electromagnetic interactions of strange particles of some proposed symmetries of the strong interactions are discussed. A minimal electromagnetic coupling is assumed. It is shown that if the interactions with both π- and K-mesons of the nucleon and cascade particle are identical, if one neglects the $n-\Xi$ mass difference, and if charge independence is satisfied, then the electromagnetic form factors of the Λ^0 and Σ^0, and in particular their magnetic moments, vanish. This is independent of any assumed relation between the Λ and Σ interactions, such as global symmetry. It is also shown that the same conditions, together with charge conjugation invariance, imply a generalized form of the Pais—Jost-Pugh theorem about processes involving only meson or photon external lines. If there is still more symmetry for the strong interactions, in the case where the π interactions are globally symmetric and the K interactions also have this doublet structure, it is shown that the K^0 acts as a completely neutral particle insofar as electromagnetic interactions are concerned.

530.14

13005. THE COUPLING CONSTANTS OF STRONG INTERACTIONS. S.Miyachi.
Progr. theor. Phys., Vol. 17, No. 3, 515-16 (March, 1957).

Using perturbation theory, the orders of magnitude of strange particle interactions are estimated. It is found that it may be possible to assume a universality of coupling constants.

W.A.Hepne

530.1

13006. STATUS OF WEAK INTERACTIONS. M.Gell-Mann.
Rev. mod. Phys., Vol. 31, No. 3, 834-8 (July, 1959).

Review. Topics discussed include: the hypothesis of a conserved vector baryon current and the consequent "weak magnetism"; the idea of a self-interacting current, and its isotopic spin character; the possibility of an intermediary vector particle; the surmised $|\Delta T| = \frac{1}{2}$ rule. J.C.Taylo

530.14

13007. REACTIONS INVOLVING POLARIZED ZERO REST MASS PARTICLES. Chzhou Guan-Chzhao.
Zh. eksper. teor. Fiz., Vol. 36, No. 3, 909-18 (1959). In Russian.

The group theoretical viewpoint is employed to describe the spin states of particles possessing zero rest masses. Complete sets of operators and their eigenfunctions in momentum and spin representations are obtained for a two-particle system. Statistical tensors for particles produced in reactions of the $a + b \to c + d$ or $a \to c + d$ types have been obtained in the case when one of the particles does not possess a rest mass. The most general selection rules for the $a + b \to c + d$ reaction are derived in the form of a relation between statistical tensors under the condition of conservation of space and time parity. The wave-functions of a system consisting of two identical particles with zero rest mass are calculated.

530.145

008. CONNECTION BETWEEN THE ISOROTATOR MODEL OF HE HOT PARTICLES AND THE D'ESPAGNAT–PRENTKI HEORY. G.Pócsik.
:ta phys. Hungar., Vol. 10, No. 1, 121-4 (1959).
The isobaric-spin properties of a theory of Rayski (Abstr. 6521 1959) are shown to be closely related to those postulated by Espagnat and Prentki (Abstr. 2668 of 1956) for the classification elementary particles. R.J.N.Phillips

530.145

009. STRUCTURE SINGULARITIES OF ELECTROMAGNETIC ORM FACTORS. R.Oehme.
uovo Cimento, Vol. 13, No. 4, 778-89 (Aug. 16, 1959).
In local field theories the form factors of particles can have ngularities which are characteristic for the structure of these part-les as composite systems. These "structure singularities" are udied with the help of examples from perturbation theory. Their athematical properties are described for real and complex values the mass variable, and their physical implications are discussed.

530.145

010. ON THE PARTICLE–HOLE RELATION IN SYSTEMS OF LMOST INDEPENDENT FERMI PARTICLES. G.Lüders.
. Naturforsch., Vol. 14a, No. 1, 5-7 (Jan., 1959). In German.
It is shown that the relation between states of particles and les becomes more general and more transparent if it is chosen an antilinear relation. W.A.Hepner

530.145 : 539.18

WAVE FUNCTION FOR THE FREE ELECTRON.
ee Abstr. 12724

530.145

011. PAULI–GÜRSEY TRANSFORMATIONS AND ROTATIONS CHARGE SPACE. E.Corinaldesi and L.A.Radicati.
uovo Cimento, Vol. 13, No. 3, 667-9 (Aug. 1, 1959).
Pauli-Gursey transformations are isomorphic with the three-mensional rotation group, and may provide a description of charge space". This is demonstrated explicitly for the case of a on-linear equation, proposed by Heisenberg, which is invariant der such rotations. R.J.N.Phillips

530.145

012. SPIN–ORBIT POTENTIAL IN PSEUDOSCALAR THEORY. .Butkov.
uovo Cimento, Vol. 13, No. 4, 809-17 (Aug. 16, 1959).
The Levy–Klein method is used to calculate, for pseudoscalar oupling, the spin–orbit potential between two nucleons. The results, rried to two lowest orders in the ratio of meson to nucleon mass, dicate an attractive force for the isotopic spin triplet state and a naller repulsive force for the singlet state. Quantitative agree-ent with phenomenological potentials depends, however, on the dr-suppression effects which are still uncertain.

530.145

013. GENERALIZATION OF THE LEVINSON–JAUCH THEOREM O AN ARBITRARY NUMBER OF CHANNELS. E.Kazes.
uovo Cimento, Vol. 13, No. 5, 983-7 (Sept. 1, 1959).
For a system having a finite number of channels the bound tates of the free and complete Hamiltonian are shown to be simply elated to the determinant and trace of the S-matrix.

530.145

014. DYNAMICS OF A SYSTEM OF SPIN 1 PARTICLES.
.T.Mahanthappa, P.M.Mathews and J.Rau.
hys. Rev., Vol. 115, No. 2, 478-81 (July 15, 1959).
The time variation of the dipole and quadrupole polarizations of system of spin 1 particles is discussed. The case of axially sym-metric external fields is treated in detail and it is shown that this rnishes a canonical representation for the polarization dynamics. lementary techniques are used to obtain an enumeration of the onstants of motion and a geometric representation of the time de-endence of the multipole polarizations.

530.145

015. TWO THEOREMS ON SCATTERING. I.I.Zinnes.
uovo Cimento Suppl., Vol. 12, No. 1, 87-99 (1959).
The following theorems are proved: (1) any wave-packet representing a free particle develops in time in such a manner that the probability of finding the particle in any finite region of space vanishes in the limit as $t \to \pm\infty$; (2) in a multi-channel scattering process the set of (free) Hamiltonians defining the asymptotic motion of the fragments is unique. E.J.Squires

530.145 : 537.533

13016. THEORY OF MULTIPLE SCATTERING: SECOND BORN APPROXIMATION AND CORRECTIONS TO MOLIÈRE'S WORK.
B.P.Nigam, M.K.Sundaresan and Ta-You Wu.
Phys. Rev., Vol. 115, No. 3, 491-502 (Aug. 1, 1959).
The formula given by Molière (Abstr. 3225 of 1947; 609 of 1949) for the scattering cross-section of a charged particle by an atom, on which has been based the formula for the "screening angle" χ_α in his theory of multiple scattering, has been examined and found to contain an inconsistent approximation in all orders of the parameter $\alpha_1 = zZ/137\beta$ except the lowest (the first Born approximation). In the present work, the correct expression of Dalitz is used for the single-scattering cross-section of a relativistic Dirac particle by a screened atomic field up to the second Born approximation. It is found that the effect of the deviation from the first Born approximation on the screening angle is much smaller than Molière's expression for this quantity would lead one to believe. This is so because the deviation from the first Born approximation is very small at the small angles that go into the definition of the screening angle. In Molière's work, all the effect of the deviation from the first Born approximation on the distribution function $f(\theta)$ for multiple scattering is contained in the quantity B which depends only on χ_α. In the present work, it is shown that in a consistent treatment of terms of various orders in α_1, there exist additional terms of order $zZ/137$ in the distribution function. These terms, which represent the second Born approximation, become important at large angles. Calculations have been carried out for the scattering of 15.6 MeV electrons by Au and Be. The 1/e widths of the distribution function obtained are in good agreement with the experimental result of Hanson et al., whereas Molière's theory gives too great a width compared with the experimental value in the case of Be.

530.145

13017. FORMAL THEORY OF SCATTERING IN THE QUANTUM FIELD THEORY. S.Tani.
Phys. Rev., Vol. 115, No. 3, 711-20 (Aug. 1, 1959).
The advantages of the exponential form of the transformation function are exploited. It is shown how to define the representation in which all effects of the self-field of physical particles on themselves are eliminated while the remainder is presented in the form of an effective velocity-dependent potential among them. One can speak of the transformation function which transforms eigenfunctions of the free-particle Hamiltonian into eigenfunctions of the total Hamiltonian: the paradox, which has been pointed out by Van Hove and further studied by Haag with regard to the existence of such a transformation function in quantum field theory, can be circumvented by considering the exponent as its representative. This exponent has a Lorentz-invariant representation. The exponent of the S-matrix is related in a very simple manner to the exponent of the transformation function over a finite interval of time. The asymptotic condition as used in the quantum field theory is also analysed from our viewpoint.

530.145

13018. STRUCTURE OF THE VERTEX FUNCTION.
S.Deser, W.Gilbert and E.C.G.Sudarshan.
Phys. Rev., Vol. 115, No. 3, 731-5 (Aug. 1, 1959).
An integral representation as a function of invariants is found for the Fourier transform of the matrix element between the vacuum and a one-particle state of the retarded commutator of two currents. A special case is a spectral representation for the vertex as a function of momentum transfer. The threshold in this representation is lower than that found in the usual perturbation theory.

530.145

13019. S-MATRIX POLES IN THE DETERMINATION OF PARITIES.
G.Feldman and T.Fulton.
Phys. Rev. Letters, Vol. 3, No. 1, 64-6 (July 1, 1959).
Practical difficulties in studying S-matrix poles in unphysical regions are discussed. A cautionary example is given: the process $\pi^- + p \to \pi^0 + n$ at 220 MeV seems to indicate a "one pion exchange" pole, which however is highly unacceptable. R.J.N.Phillips

530.145

13020. A FORMAL OPTICAL MODEL. J.S.Bell and E.J.Squires.
Phys. Rev. Letters, Vol. 3, No. 2, 96-7 (July 15, 1959).

An equivalent one-body potential for elastic scattering from a complex target is constructed, taking account of the exclusion principle. The prescription of Frantz and Mills (Abstr. 1700 of 1959) is criticised. R.J.N.Phillips

530.145

13021. THE PROBLEM OF THE TWO-NUCLEON INTERACTION IN THE TAMM–DANCOFF METHOD. A.A.Rukhadze.
Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 511-12 (Aug., 1958).
In Russian. English translation in: Soviet Physics–JETP (New York), Vol. 35(8), No. 2, 352-4 (Feb., 1959).

In a previous paper [Trudȳ Tbilisskogo Politekhnicheskogo Instituta, Vol. 4, 185 (1957)] the author developed a non-adiabatic treatment of the two-nucleon interaction in the Tamm–Dancoff method. Numerical results, using the new theory, are now presented for the bound state of the deuteron and the scattering of nucleons in the $^1S_0$ state, and are compared with experiment. For low energies (< 20 MeV) the theory gives good qualitative agreement with experiment; for high energies (> 50 MeV) the two-meson approximation used in the theory appears to break down. J.W.Gardner

530.145 : 539.12

13022. ISOTOPIC INVARIANCE IN ANTIHYPERON PROCESSES. S.G.Matinyan and G.R.Khutsishvili.
Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 546-7 (Aug., 1958).
In Russian. English translation in : Soviet Physics–JETP (New York), Vol. 35(8), No. 2, 377-8 (Feb., 1959).

Specific inequalities between cross-sections for the production and interaction processes of antihyperons are set up on the basis of the principle of isotopic invariance. Violation of these inequalities would indicate absence of such invariance in antihyperon reactions. S.J.St-Lorant

530.145

13023. RENORMALIZATION OF THE VERTEX PART IN PSEUDOSCALAR MESON THEORY. V.N.Gribov.
Zh. eksper. teor. Fiz., Vol. 36, No. 2, 554-9 (1959). In Russian.

Renormalization of the vertex part in pseudoscalar meson theory is studied with aid of spectral representations for the mean (with respect to vacuum) of the T-product of the three Heisenberg operators (see Abstr. 7682 of 1958). The problem of the magnitude of the renormalization constants is discussed. An expression for Z_1 in terms of the spectral functions is found and the relation between these spectral functions and the spectral functions in the Källen–Lehmann representations for single-particle Green's functions is established.

530.145

13024. INTEGRAL EQUATIONS FOR THE SCHRÖDINGER WAVE FUNCTION. W.Tobocman and L.L.Foldy.
Amer. J. Phys., Vol. 27, No. 7, 483-90 (Oct., 1959).

For many problems in quantum mechanics it proves to be useful to write the Schrödinger equation as an integral equation rather than as a differential equation. In this paper we describe how the transformation of the Schrödinger equation from differential form to integral form may be accomplished. Two methods are described, one appropriate to bound state theory and one appropriate to scattering theory. It is shown that the bound state wave-function is also a solution of the integral equation (Lippman–Schwinger equation) appropriate to scattering theory.

530.145

13025. QUANTUM MECHANICAL TREATMENT OF SYSTEMS WITH A DAMPING FORCE PROPORTIONAL TO THE VELOCITY. V.W.Myers.
Amer. J. Phys., Vol. 27, No. 7, 507-8 (Oct., 1959).

It is possible to construct a Hamiltonian that leads to a velocity dependent damping force. The resulting Hamiltonian can also be applied as an operator in the time-dependent Schroedinger equation. The quantum mechanical treatment of systems with $V(x) = 0$ and $V(x) = mgx$ is presented, and the results are compared with the classical formulation.

530.145

13026. ENERGY MOMENT METHOD IN QUANTUM MECHANICS. P.M.Parker and L.C.Brown.
Amer. J. Phys., Vol. 27, No. 7, 509-14 (Oct., 1959).

An approach different from the conventional ones to certain nondiagonal quantum mechanical eigenvalue problems is presented The procedure described relates the physical parameters associat with the description of a quantum mechanical system to energy eigenvalues of the wave-equation of the system in such a manner th for relatively simple systems the physical parameters can be eval uated from experimental data without effecting a detailed solution for the roots of the secular equation. Thus the energy moment method serves as an additional tool in data analysis. Results of th application of the energy moment method to two particular physica systems are included.

530.14

13027. ERGODIC THEOREM IN QUANTUM MECHANICS. EVALUATION OF THE PROBABILITY OF AN EXCEPTIONAL INITIAL CONDITION. G.M.Prosperi and A.Scotti.
Nuovo Cimento, Vol. 13, No. 5, 1007-12 (Sept. 1, 1959).

An evaluation is made of the probability of finding an exception initial condition in the sense of the Bocchieri–Loinger formulation of the quantum ergodic theorem. The result is compared with that obtained by Pauli and Fierz who made a corresponding evaluation of the probability of finding a non-thermodynamical macro-observe in the original von Neumann formulation.

530.14

13028. NOTE ON SYMMETRY OPERATIONS IN QUANTUM MECHANICS. R.Hagedorn.
Nuovo Cimento Suppl., Vol. 12, No. 1, 73-86 (1959).

Following an exposition of the connection between symmetries and unitary or antiunitary representations, a simplified proof for the antiunitary case is given. W.A.Hepne

530.14

13029. DENSITY MATRICES FOR WAVE FUNCTIONS BUILT UP FROM NON-ORTHOGONAL TWO-ELECTRON ORBITALS. E. Kapuy.
Acta. phys. Hungar., Vol. 10, No. 1, 125-7 (1959).

Approximate expressions are given for the Löwdin density matrices of first and second order for antisymmetrized products of two-electron functions. J.Hawgoo

530.1

13030. LIMITING PROPERTY OF THE MEAN WAVE IN THE FUNCTIONAL THEORY CF SYSTEM OF PARTICLES. J.L.Destouches.
C.R. Acad. Sci. (Paris), Vol. 248, No. 19, 2722-4 (May 11, 1959).
In French.

Subject to five conditions, the mean wave of a large number of particles, formulated within the nonlinear functional theory, satisf a linear equation, which is identical to the wave-equation in the us wave mechanics. J.K.Skwirzyns

530.1

13031. INTERACTIONS BETWEEN MATTER AND RADIATION, ACCORDING TO THE FUNCTIONAL THEORY. J.L.Destouches and Pham Xuân Yêm.
C.R. Acad. Sci. (Paris), Vol. 248, No. 21, 2959-61 (May 25, 1959).
In French.

Considering a system of one electron and a great number N of photons, the authors show that subject to the five conditions of Destouches (see preceding abstract), the electromagnetic equations associated with N photons are the linear Maxwell's equations as formulated by de Broglie. Furthermore, the electromagnetic poten tials created by these N photons are equal to the potentials associated with the mean wave of the photons, when acting on an electron J.K.Skwirzyns

STATISTICAL MECHANICS
TRANSFER PROCESSES

530.1

13032. DERIVATION OF RATE EQUATIONS: CORRECTIONS AN FURTHER COMMENTS. R.Ingraham.
Nuovo Cimento, Vol. 13, No. 2, 461-3 (July 16, 1959).

In this note the author retracts in large part his critique (Abstr. 65 of 1959) of the weak-coupling theories of irreversible

haviour in large systems presented by Van Hove, Brout, and 'igogine. In particular the evaluation of the asymptotic time inteals is now agreed to be free from arbitrariness, and the limit ansition operator is shown to be unitary. R.B.Stinchcombe

530.162

033. ON APPLICATION OF QUANTUM FIELD THEORY ETHODS TO PROBLEMS OF QUANTUM STATISTICS AT FINITE EMPERATURES.
A.Abrikosov, L.P.Gor'kov and I.E.Dzyaloshinskii.
1. eksper. teor. Fiz., Vol. 36, No. 3, 900-8 (1959). In Russian.
A formulation of the thermodynamic perturbation theory is 'oposed which permits one in full measure to apply the quantum eld theory methods to quantum statistics at finite temperatures. ne method is an extension of the Matsubara technique and is based 1 expansion of the Green's functions in Fourier series in an maginary time" variable. The technique thus arrived at differs om the usual diagram technique for T = 0 in that summation over screte values of the imaginary frequency is substituted for integtion over the frequencies. The analytical properties of the urier components of the Green's functions are investigated. It is own that due to the possibility of analytic continuation for solution various kinetic and nonstationary problems it is sufficient to ow the corresponding equilibrium Green's functions.

530.162

3034. TIME–SPACE PROCESSES IN STOCHASTIC MEDIA. I-II. Litwiniszyn.
ull. Acad. Polon. Sci. Ser. Sci. tech., Vol. 6, No. 1, 1-6 (1958); ol. 7, No. 5, 319-26 (1959).

530.162

3035. PROBABILITY DENSITY. POSITIVITY AND ORDER. Bertaut.
R. Acad. Sci. (Paris), Vol. 249, No. 1, 27-9 (July 6, 1959). French.
A preliminary note in which an expansion analagous to the arlier–Gram-Edgeworth series for a probability density is given ich is everywhere positive and, in certain conditions, ordered in der of magnitude and polynomial degree. G.A.Chisnall

530.162

3036. FREE ENERGY OF A SYSTEM OF CHARGED PARTICLES. R.Yukhnovskii.
okl. Akad. Nauk SSSR, Vol. 126, No. 3, 557-60 (May 21, 1959). Russian.
The classical free energy of a system of several interacting ions calculated by a regrouping of the divergent Coulomb terms, without introducing an artificial screening. It is shown that, up to the ird virial coefficient, one can use the superposition principle for e triple distribution function. J.Lascoux

530.162

3037. CALCULATION OF PARTITION FUNCTIONS. J.Hubbard.
hys. Rev. Letters, Vol. 3, No. 2, 77-8 (July 15, 1959).
A transformation due to Stratonovich (Abstr. 2814 of 1958) is sed to calculate approximately the grand partition function of a any-body system. The relation of some of the results to those otained in the theories of Hartree–Fock and of Brueckner and ell-Mann are discussed. T.R.Carson

530.162

3038. A REMARK ON LUDWIG'S PROOF OF THE ERGODIC HEOREM. J.Schröter.
.Naturforsch., Vol. 14a, No. 8, 750-1 (Aug., 1959). In German.
A discussion of the assumptions necessary for deriving the rgodic theorem. P.M.Davidson

530.162 : 537.311.1

3039. ON A METHOD OF CALCULATING ELECTRICAL ONDUCTIVITY. V.L.Bonch-Bruevich.
h. eksper. teor. Fiz., Vol. 36, No. 3, 924-6 (March, 1959). Russian.
A new method of calculating the reaction of a system of particles n an external field which uses the apparatus of Green's quantum nctions is advanced. It is illustrated for the case of electrical onductivity but is also applicable to any parameter characterizing eacting systems. A.L.Mackay

530.162 : 536.48

POSSIBLE SUPERFLUIDITY OF A SYSTEM OF STRONGLY INTERACTING FERMIONS. See Abstr. 12187

530.162 : 539.2

ON THE STATISTICS OF SPIN AND POLAR EXCITATIONS IN CRYSTALS. See Abstr. 12795

530.162

13040. CORRELATION FUNCTION METHOD FOR TRANSPORT PHENOMENA. H.Mori.
Phys. Rev., Vol. 115, No. 2, 298-300 (July 15, 1959).
An expression for the nonequilibrium density matrix is derived in terms of dynamical fluxes, which leads to a rigorous formulation of the correlation function method for transport phenomena with nonuniform thermodynamic quantities.

530.162 : 537.311.1

GENERAL THEORY OF TRANSPORT: DIFFERENCE BETWEEN ELECTRIC FIELD AND DENSITY GRADIENT. See Abstr. 12231

530.162 : 539.2

TRANSPORT PHENOMENA IN ELASTIC ANISOTROPIC METALS. See Abstr. 13788

530.19

13041. DIFFUSION APPROXIMATION TO THE EQUATION OF RADIATIVE ENERGY TRANSFER. V.I.Kuznetsov.
Optika i Spektrosk., Vol. 5, No. 5, 606-11 (1958). In Russian.
It is shown that if luminance (brightness) in the radiative transfer equation is expanded in Legendre polynomials only as far as the second term, then the transfer equation reduces to a diffusion-type equation. The author estimates the distance from the radiative energy source at which this diffusion equation solution applies in media for which $\rho \gg k_0$ holds (ρ and k_0 are the scattering and absorption coefficients respectively). The diffusion equation is solved for the particular case of a semi-infinite scattering and absorbing medium with one plane surface. A.Tybulewicz

GENERAL MECHANICS
MECHANICS OF SOLIDS

531.224

13042. THEORY OF BEAMS COMPOSED OF TWO ELASTIC MATERIALS. A.W.Simon.
Amer. J. Phys., Vol. 27, No. 7, 500-2 (Oct., 1959).
The theory involved in locating the neutral axis of a beam composed of two elastic materials (composite beam) is given. It is shown that the resulting flexural rigidity of such a beam is equal to the sum of the flexural rigidities of its parts. With these two factors, the tensile strain, tensile stress, slope, and deflection of the beam can be calculated from the usual formula. The shear stress is also calculated.

531.25 : 535.55

13043. MATERIAL FRINGE VALUE SIGN REVERSAL IN PARAPLEX AND CASTOLITE. H.Becker.
J. appl. Phys., Vol. 29, No. 12, 1771-2 (Dec., 1958).
For Paraplex and Castolite the sign of the material fringe value at room temperature is the same as for most other plastics (e.g. Catalin, Fosterite and Marco Resin) but the opposite sign occurs in the stress frozen plastic. H.G.Jerrard

531.25 : 535.55

13044. INVESTIGATION OF THE SUITABILITY OF SOME PLASTICS AS PHOTOELASTIC MODEL MATERIALS. E.Mönch and T.Hautmann.
Z. angew. Phys., Vol. 11, No. 1, 35-9 (Jan., 1959). In German.
The results are reported of a study made of 12 plastics available commercially in Germany. Their performances are compared with those of celluloid and polystyrene. H.G.Jerrard

531.35

13045. CENTRIFUGAL AND CORIOLIS FORCES AS OBSERVED IN A ROTATING SYSTEM. A.G.Rouse.
Amer. J. Phys., Vol. 27, No. 6, 429 (Sept., 1959).

An experimental arrangement, consisting of a rotating turntable on which a steel ball can roll under the influence of an electromagnet, is described. The purpose is to demonstrate what an observer in the rotating system sees when the force holding a particle moving in a circular path suddenly ceases to operate.
S.Weintroub

531.36 : 532.595

13046. THE STABILITY OF EQUILIBRIUM OF A SOLID CONTAINING CAVITIES FILLED WITH A LIQUID. V.V.Rumyantsev.
Dokl. Akad. Nauk SSSR, Vol. 124, No. 2, 291-4 (1959). In Russian.

The author expands the treatment of Lyapunov [Zapiski Akademii Nauk, Vol. 22, No. 5 (1908)] concerning oscillations of a porous solid body filled with a homogeneous, incompressible liquid, under the action of surface and mass forces. In particular, a proof is presented that the total potential energy V of the system in stable equilibrium (as defined by Lyapunov) is minimum, V_0. The paper contains a useful summary of the Lyapunov's ideas on the subject of equilibrium. J.K.Skwirzynski

531.43 : 539.62

REDUCTION OF STATIC FRICTION BY SONIC VIBRATIONS. See Abstr. 13870

531.571 : 534.222.2

X-RAY STUDY OF EXPLOSIVELY ACCELERATED METAL SYSTEMS. See Abstr. 11935

MECHANICAL MEASUREMENTS

531.715.2 : 778.34

SEMIAUTOMATIC MEASUREMENT OF GAP LENGTHS IN NUCLEAR EMULSIONS. See Abstr. 12957

531.717.1

13047. USE OF Fe^{55} FOR MEASURING TITANIUM COATING THICKNESS. P.D.Zemany.
Rev. sci. Instrum., Vol. 30, No. 4, 292-3 (April, 1959).

The thickness of titanium coatings on Kovar was measured by exciting the Ti Kα radiation by an Fe^{55} source and using a proportional counter to record the Ti Kα counting rate. The counter was shielded from direct radiation from the source. Suitable isotopes are available for use with other coating materials. T.Mulvey

531.719.2 : 535.81

13048. REFRACTION NEAR THE EARTH'S SURFACE AND OPTICAL DISTANCE-MEASUREMENT. F.Ackerl.
Z. InstrumKde, Vol. 67, No. 3, 48-52 (March, 1959). In German.

Possible refraction effects are reviewed and it is shown that, for the most accurate measurement of distance with vertical stadia rods, the refraction can lead to appreciable errors. Experiments to measure the effects are outlined. R.W.Fish

531.75 : 536.421

A DILATOMETRIC STUDY OF GALLIUM AT ATMOSPHERIC PRESSURE. See Abstr. 12176

MECHANICS OF FLUIDS

532.12 : 539.383

FLOTATION METHOD OF MEASURING COMPRESSION COEFFICIENTS OF HARD SUBSTANCES AND LIQUIDS. See Abstr. 13860

532.123

13049. STRESS-OPTICAL ANALYSIS OF FLUIDS. W.Philippoff.
Industr. engng Chem., Vol. 51, No. 7, 883-4 (July, 1959).

Measurements were made of birefringence, shear stress and extinction angle as functions of the rate of shear in silicone solutions; and also measurements of the pressure distribution in capillaries. An analysis of the results supports the existence of elasticity in these fluids, similar to elasticity in a solid, and it is estimated that the magnitude of the recoverable shear strain can sometimes be of the order of hundreds. J.G.Oldroyd

532.1

13050. A METHOD FOR MEASURING THE DYNAMIC VISCOSITY AND DYNAMIC RIGIDITY OF VISCO-ELASTIC LIQUIDS. II.
Ali Abdel Kerim Ibrahim.
Acta phys. Hungar., Vol. 10, No. 1, 111-14 (1959).

An extension of the calculation in Abstr. 4333 of 1959, claiming increased accuracy. J.G.Oldroyd

532.133 : 537.226

VARIATION OF VISCOSITY WITH DIELECTRIC RELAXATION TIME. See Abstr. 13245

532.1

13051. VISCOSITY OF ELECTROLYTE SOLUTIONS. CALCULATION OF THE CONCENTRATION AND TEMPERATURE DEPENDENCE BY THE EXPONENT METHOD. L.Andrussow.
Z. Elektrochem., Vol. 62, No. 5, 608-15 (1958). In German.

A discussion of specific examples concerning the application of the exponent method to the dependence of the viscosity of dilute solutions of electrolytes upon concentration. R.Schnurmann

532.5

13052. THE POSSIBILITY OF OBTAINING EXACT INTEGRALS OF REYNOLD'S EQUATION IN A CLOSED FORM. Ya.M.Kotlyar.
Dokl. Akad. Nauk SSSR, Vol. 127, No. 1, 59-62 (July 1, 1959).
In Russian.

The pressure of a viscous fluid (e.g. a lubricant) moving in a narrow clearance between a plane and a cylindrical surface, is a solution of Reynold's equation. When the clearance is expressible in terms of some periodic functions, in particular if it is porportional to

$$[1 + 3\cot^2(x/2)]^{-2/3},$$

the Reynold's equation can be solved exactly in terms of a harmonic function (i.e. a solution of Laplace's equation) satisfying the same boundary conditions. In the particular case considered, the author finds that the auxiliary harmonic function is expressible in terms of the "theta" functions. J.K.Skwirzynski

532.517 : 539.5

13053. HELICAL FLOW OF GENERAL FLUIDS.
B.D.Coleman and W.Noll.
J. appl. Phys., Vol. 30, No. 10 1508-12 (Oct., 1959).

The problem of the helical flow of a general fluid is solved making no special constitutive assumptions other than incompressibility. It is shown that from a knowledge of the rheologists' viscosity function one can calculate the dependence of the velocity field in helical flow on the geometry and applied forces. The complete stress distribution (including normal stresses) may be calculated from a knowledge of three basic material functions which can, in principle, be determined from an experimental study of simple shearing flow. Expressions are derived for the discharge rate and for the angular velocities of the bounding cylinders as functions of the applied force

532.5

13054. INTEGRATION THEORY FOR ONE-DIMENSIONAL VISCOUS FLOW. G.Rosen.
Phys. of Fluids, Vol. 2, No. 5, 517-20 (Sept.-Oct., 1959).

The velocity of unsteady, one-dimensional real fluid flows is rigorously eliminated from the governing equations. A class of exact solutions for polytropic processes is then derived and discussed. The general solution for tangent-gas behaviour is presented

532.517.2 : 536.

FLOW BETWEEN COOLED, PARALLEL PLATES. HEAT TRANSFER AND TEMPERATURE DISTRIBUTION. See Abstr. 12170

532.517

13055. A PARTICULAR NON-NEWTONIAN FLOW. DILUTE FIBER SUSPENSIONS. J.W.Daily and G.Bugliarello.
Industr. engng Chem., Vol. 51, No. 7, 887-8 (July, 1959).

Observations on suspensions of papermaking fibres in the range of concentration 0.1 to 1% flowing in transparent vertical pipes of different sizes show how an annulus of clear water separates a solid plug of entangled fibres from the pipe wall. The friction factor plotted against Reynolds number suggests a transition to turbulence in the annulus under certain conditions. J.G.Oldroyd

532.52 : 536.

MOVING FLAME EXPERIMENT. VERTICAL ANGULAR MOMENTUM OF HEATED LIQUID. See Abstr. 12172

532.525

56. THE INFLUENCE OF THE WEBER AND REYNOLDS MBERS ON THE DISPERSION OF HIGH-SPEED LIQUID JETS. odu.
t. Acad. Sci. (Paris), Vol. 249, No. 4,499-501 (July 27, 1959).
French.
The dispersion or increase in diameter of a high-speed liquid in air is shown experimentally to be linear. The dispersion le depends more strongly on the Weber number than on the ynolds number. P.G.Morgan

532.527

57. MAXIMUM PRINCIPLES FOR VORTICITY IN VISCOUS UID. T.Kato and H.Fujita.
Phys. Soc. Japan, Vol. 14, No. 4, 545 (April, 1959).
Maximum conditions for vorticity are given in the two dimensional case for stationary and non-stationary flow. The theorems en are proved and it is stated that while they cannot in general extended to three dimensions, they are valid in special cases, . stationary axially symmetric flow. T.C.Toye

532.54 : 536.24

HEAT TRANSFER IN VISCOUS–GRAVITATIONAL QUID FLOW IN CHANNELS. See Abstr. 13212

532.542

358. LAMINAR FLOW IN THE ENTRANCE REGION OF A OROUS PIPE. H.L.Weissberg.
ys. of Fluids, Vol. 2, No. 5, 510-16 (Sept.-Oct., 1959).
The equation of motion for steady, incompressible, axially mmetric flow in a pipe with uniform wall suction or injection is pressed in terms of a "dimensionless stream function," $\xi, \eta) = \Psi(x, r)/\Psi(x, a)$, where Ψ is the usual stream function, nd r are cylindrical polar coordinates, a is the radius of the pipe, $= 1 - [2Rx/(aN)]$, $\eta = (r/a)^2$. R and N are Reynolds numbers which ecify the flows through the pipe wall and through the inlet, spectively. This equation, which includes as a special case the uation previously obtained by Yuan and Finkelstein [Transactions the American Society of Mechanical Engineers, Vol. 78, 719 956)] for similar (affine) velocity profiles, is greatly simplified passing to the limit which is approached as N increases. Nonmilar, ξ-independent solutions are approximated by a generalition of the method applied by Morduchow to the ξ-independent uation of Yuan and Finkelstein. The results show the manner in nich the condition of similarity of the velocity profiles is approached r a prescribed (e.g., parabolic) inlet profile. They also indicate e development of reverse flow at the wall of the pipe in the range R values for which no similar solutions exist.

532.582.2

059. THE FLOW WITH WAKE PAST AN OBLIQUE PLATE. Mimura.
Phys. Soc. Japan, Vol. 13, No. 9, 1048-55 (Sept., 1958).
For the case of the two-dimensional flow of a perfect fluid, the essure distributions on the front surface of the plate, as well as the free streamlines, are calculated, together with the shapes of e latter, by applying the method of the notched hodograph devised Roshko. The calculated values are compared with the experiental ones obtained by Fage and Johansen. It is thus found that e calculated and the observed values of the pressure distribution ong the front surface of the plate coincide fairly well with each her, as long as the observed base pressure is constant, but screpancies between them increase as the angle of attack decreases.

532.59

3060. THE ASYMPTOTIC FORM OF DIVERGENT WAVES OF XIAL SYMMETRY IN A LIQUID SUBJECT TO GRAVITY. V.Iordanskii.
okl. Akad. Nauk, SSSR, Vol. 125, No. 6, 1211-12 (April 21, 1959).
Russian.
The flow potential for waves of the above kind is derived under e condition that it should vanish at large distances from the axis symmetry. An asymptotic expression for the potential is btained in analytic form. R.Eisenschitz

532.591

3061. SPEED OF STRAIGHT WAVES IN A RIPPLE TANK. .B.Clark.
mer. J. Phys., Vol. 27, No. 7, 478-83 (Oct., 1959).
The appropriate hydrodynamic relations are developed in a anner that utilizes mathematics which is no more complicated than the expression for the total derivative of a function of more than one variable. Expressions for the speed of propagation are obtained in two cases; first the surface tension is neglected, then it is taken into account. The equation for the trajectories of the particles of water is obtained.

532.595 : 531.36

EQUILIBRIUM OF A SOLID CONTAINING CAVITIES FILLED WITH A LIQUID. See Abstr. 13046

532.61.08

13062. MEASUREMENT OF Λ VARIABLE SURFACE TENSION. F.Palmer.
Amer. J. Phys., Vol. 27, No. 6, 431 (Sept., 1959).
A DuNuoy tensiometer is well adapted for the measurement of the surface tension of a liquid, the surface tension of which varies with time, as for example a dilute soap solution. For a solution consisting of one drop of sodium stearate in 100 cm^3 of distilled water, using the technique described, the minimum time for a measurement is about 7 sec during which the surface tension drops 10-15 dynes/cm below that of distilled water. S.Weintroub

532.65 : 539.17

DISRUPTION OF A CHARGED LIQUID DROP. See Abstr. 12691

MOLECULAR THEORY OF LIQUIDS

532.7 : 533.7

13063. A METHOD OF MOMENT APPROXIMATIONS IN GENERALIZED HYDRODYNAMICS. I.I.Ol'khovskii.
Dokl. Akad. Nauk SSSR, Vol. 126, No. 4, 748-51 (June 1, 1959).
In Russian.
A method of approximately solving Boltmann's equation is described, which should hold for time intervals not necessarily large compared with the mean free time. The distribution function is expanded in a series of three-dimensional Hermite polynomials and Boltzmann's equation written in terms of the expansion coefficients ('moments'). The collision terms are simplified using an approximation which is exact for inverse-fifth-power molecules, with the result that the lower-order collision terms can be expressed in terms of a single relaxation time. For a given integer s, the transformed Boltzmann equation can be approximated by neglecting all moments of order $> s$. For $s = 1$ this is the adiabatic approximation; for $s = 2$, it takes into account the transport and relaxation of anisotropic pressure as well. The author discusses the relation between this method and the Chapman–Enskog method, the Navier–Stokes equation, and Grad's 13-moment approximation. O.Penrose

532.7

13064. THE ASYMMETRY OF THE DISTRIBUTION OF THE COORDINATION NUMBER OF MOLECULES IN WATER. V.K.Prokhorenko, O.Ya.Samoilov and I.Z.Fisher.
Dokl. Akad. Nauk. SSSR, Vol. 125, No. 2, 356-8 (1959). In Russian.
This asymmetry (skewness) is measured by the average cubed deviation, from its mean value, of the number of particles in an arbitrary sphere of radius equal to the first minimum of the radial distribution function. This average cubed deviation was estimated using the observed radial distribution function together with the Kirkwood superposition approximation. For argon and mercury the skewness was small and negative. For water, however, it was large and positive; this fact is interpreted in terms of a short-range order in water similar to that in ice. O.Penrose

532.7

13065. TRANSPORT COEFFICIENTS OF DENSE FLUIDS OF MOLECULES INTERACTING ACCORDING TO A SQUARE WELL POTENTIAL. H.C.Longuet-Higgins and J.P.Valleau.
Molecular Phys., Vol. 1, No. 3, 284-94 (July, 1958).
A simplified kinetic theory is described for spherical molecules interacting according to a square well potential. The statistical premises of this theory correspond closely to those of Longuet-Higgins' and Pople's theory of dense fluids of rigid spheres. The thermal conductivity λ, shear viscosity η and bulk viscosity κ are

predicted to be in the ratio

$$\lambda : \eta : \kappa = \frac{k}{2} : \frac{m}{5} : \frac{m}{3},$$

where k is Boltzmann's constant and m the mass of a molecule. To calculate any of these coefficients absolutely requires independent information about the equilibrium pair distribution. This may be obtained from the self-diffusion constant D, whose value is also given by the theory. For argon the measured value of D leads to a theoretical value for η which is in good agreement with experiment; for this liquid, however, the observed ratio $\kappa : \eta$ is very much smaller than predicted.

532.72

13066. TRANSPORT PHENOMENA IN FLUID MIXTURES.
E.U.Franck and W.Jost.
Z. Elektrochem., Vol. 62, No. 10, 1054-74 (1958). In German.

The diffusion and viscous flow of associated molecules cannot always be interpreted by the same mechanism as for non-associated liquids for which the activation energies of viscosity and diffusion are often very similar. In a gas at low pressure most of the energy exchange takes place by diffusion, whereas at high densities collision processes are predominant. Enskog's theory represents well the phenomena observed at temperatures above the critical, apart from some anomalies in the neighbourhood of the critical point. R.Schnurmann

532.72

13067. THE DIFFUSION OF TRITIUM IN LIQUID ARGON.
G.Cini-Castagnoli, A.Giardini and F.P.Ricci.
Nuovo Cimento, Vol. 13, No. 5, 916-20 (Sept. 1, 1959).

A simple expression of the diffusion coefficient as function of the temperature at constant pressure for mixtures of perfect liquids previously suggested by the authors has been checked in the case HT in liquid argon. The value obtained by the capillary method adopted for low temperature work is $D_{exp}(HT-A) = (3.17 \pm 0.15) \times 10^{-5}$ cm²/sec at $T = 84.5^{\circ}$K in satisfactory agreement with the calculated value $D_{calc}(HT-A) = 2.94 \times 10^{-5}$ cm²/sec.

532.72

13068. DIFFUSION COEFFICIENT OF ^{37}A IN LIQUID N_2.
G.Cini-Castagnoli, F.Dupré and F.P.Ricci.
Nuovo Cimento, Vol. 13, No. 2, 464-5 (July 16, 1959).

The value of $D(A^{37}-N_2)$ has been investigated to check the validity of earlier work on $A^{40}-N_2$ and $HT-N_2$ diffusions.
G.I.W.Llewelyn

532.72

13069. THERMAL DIFFUSION COLUMN THEORY FOR LIQUIDS.
A.H.Emery, Jr.
Industr. engng Chem., Vol. 51, No. 5, 651-4 (May, 1959).

The theory is improved by calculating the effect of variable viscosity and diffusivity on the operating equations of the thermal diffusion column. The results show that, for some systems, the effect of temperature on the properties is important. W.Good

532.72

13070. THE TIME LAG IN DIFFUSION. III.
H.O.Pollak and H.L.Frisch.
J. phys. Chem., Vol. 63, No. 6, 1022 (June, 1959).

A sufficient condition is derived that the reduced time lag for the (one-dimensional) diffusion of a species through a membrane (with fixed surface concentrations c and 0, respectively, and initially free of the diffusing species) under the concentration dependent diffusion coefficient D(c) is a non-decreasing function of c.

532.739.2

13071. SOLUBILITY OF CARBON IN SILICON AND GERMANIUM.
R.I.Scace and G.A.Slack.
J. chem. Phys., Vol. 30, No. 6, 1551-5 (June, 1959).

The solubility of carbon in silicon was measured over the temperature range 1560° to 2900° C. The enthalpy of solution is 59 ± 3 kcal/mole. A phase diagram for the system Si—C is presented, embodying these solubility data as well as the results of other high-temperature experiments with silicon carbide. It is found that SiC possesses a peritectic point at 2830 ± 40° C. These studies were carried out in argon at pressures as high as 35 atm. Solubilities of carbon in germanium were measured in the temperature range 2780° to 3170° C, at argon pressures up to 55 atm, and a tentative phase diagram is given.

532.783 : 538.2

NUCLEAR RESONANCE INVESTIGATIONS IN LIQUID CRYSTALS. See Abstr. 12486

MECHANICS OF GASES
VACUUM TECHNIQUE

533.16

13072. THE INFLUENCE OF THE DENSITY ON THE VISCOSITY OF HELIUM GAS AT LIQUID HYDROGEN TEMPERATURES.
J.M.J.Coremans, J.J.M.Beenakker, A.van Itterbeek and P.Zandbergen.
Bull. Inst. Internat. Froid, Annexe 1958-1, 289-93.

Measurements were made with an oscillating sphere viscomet having a distance between the walls and the sphere of the order of 0.6 cm. In the region from 3 to 20 atm, an increase of the viscosit of the order of $\frac{1}{2}\%$ per atm was found. R.Schnurmar

533.15 : 539.

ISOTOPE SEPARATION BY GASEOUS DIFFUSION. See Abstr. 12729

533.275 : 551.508.7

13073. METHODS FOR MEASURING THE HUMIDITY OF AIR.
W.Haüssler.
Wiss. Z. Hochsch. Maschinenbau Karl-Marx-Stadt, Vol. 1, No. 1, 77-85 (1958/59). In German.

Descriptions, with sketches, of hair hygrometers, Ranke's automatic optical dew-point measuring instrument, Johnson's electric dew-point instrument for smoke, hygroscopic (lithium chloride) dew-point instruments, the Weiss "Hygronom", and psychrometers. J.Smut

533.5 : 531.788

13074. A NEW THERMISTOR MICROMANOMETER. D.A.Degras and P.Andrieux.
Vide, Vol. 14, 45-58 (March-April 1959). In French.

Describes some experiments that have been carried out to determine the ultimate design of thermistor manometers. Also discusses the design of such a manometer, which is suitable for th pressure range from 5 to 20 mm Hg. R.D.Huds

533.5 : 531.788

13075. A RADIOMETRIC GAUGE FOR THE MEASUREMENT OF HIGH VACUA. J.Bailleul-Langlais.
Vide, Vol. 14, 59-73 (March-April, 1959). In French.

The gauge is for the absolute measurement of pressure betwe 5×10^{-4} and 1×10^{-7} mm Hg. The measurement is dependent onl on the dimensions of the gauge and not on the nature of the gas.
R.D.Hudsc

533

13076. THE CENTRIPETAL-PUMP EFFECT IN A VACUUM PUMP. M.Reiner.
Proc. Roy. Soc. A, Vol. 247, 152-67 (Sept., 16, 1958).

An instrument is described which works as a centripetal vacu pump. It consists of two circular metal plates, one stationary, the other rotating opposite it. The stator has an opening in the centre. The rotor can be freely displaced along the axis of rotation. By centripetal pumping action it is kept floating on an air cushion of thickness D. The relation between D and the speed of rotation was determined for different weights of the rotor to be supported. The results are interpreted on the basis of Maxwell's theory of the elastico-viscosity of air.

533.5

13077. THE PRODUCTION OF ULTRA-HIGH VACUA WITH OIL DIFFUSION PUMPS. E.A.Trendelenburg.
Vide, Vol. 14, 74-9 (March-April, 1959). In French.

The author discusses the use of these pumps and describes some experiments concerned with the mechanism of cold traps. The influence is also discussed of pump designs on the time for which ultra-high vacuum systems can be kept below 10^{-10} mm Hg.
R.D.Hudsc

533.

13078. A COMPLETELY WELDED AND EASY TO OUTGAS PUMPING SYSTEM FOR HIGH VACUUM WORK. G.Mongodin.

le, Vol. 14, 95-7 (March-April, 1959). In French and English.
The system, consisting of a diffusion pump, valve and liquid rogen trap, can be permanently welded together and yet gives sy access to the internal parts of the pump and trap.
R.D.Hudson

533.59

079. VACUUM OUTGASSING OF MATERIALS AT ROOM MPERATURE. J.C.Boulassier.
ie, Vol. 14, 39-44 (March-April, 1959). In French.
Using the basic principles developed by Knudsen to measure vapour pressure of mercury, the author has measured the ecific outgassing factor ν at room temperature for a number of ganic materials and metals which are used in vacuum work.
R.D.Hudson

533.6.011.5

080. SUPERSONIC FLOW IN A TUBE WITH LONGITUDINAL LOTS. G.P.Wachtell and S.P.Carfagno.
ys. of Fluids, Vol. 2, No. 5, 521-6 (Sept.-Oct., 1959).
A differential equation is derived for the pressure along the is of a longitudinally slotted tube through which there is super- nic gas flow, for the general case in which both the tube cross- ction and the slot width vary with axial position. An approximate ethod of solution for the special case, in which the tube cross- ction and slot width are constant, is then found in closed form d confirmed experimentally to within a constant factor. This ctor is attributed to the formation of a boundary layer along the ot walls.

533.6.011.5

081. INSTABILITY IN HYPERSONIC FLOW ABOUT BLUNT DDIES. R.H.Johnson.
ys. of Fluids, Vol. 2, No. 5, 526-32 (Sept.-Oct., 1959).
Studies of the flow field associated with hypersonic helium flow er blunt bodies with surface cavities have shown a very violent stability to be connected with these cavities. The mechanism of is instability appears to involve the formation within the cavity of rtices which are subsequently ejected. Cavity shapes more con- cive to vortex formation are associated with the least stable flow. periments using the hydraulic analogy for compressible gas flow ve clarified the nature of these unstable flows. It is suggested that e violent action of such vortices may explain some of the deeper ts observed in many meteorites. The continuous ejection of rtices during atmospheric passage would ablate material from the vities, whence the depth of any cavities initially present on a eteoric body would increase during passage through the earth's mosphere.

533.6.05

082. ON QUANTITATIVE MEASUREMENT OF TURBULENCE Y MEANS OF A CONSTANT RESISTANCE HOT-WIRE ANEMO- IETER. N.Hayasi.
Phys. Soc. Japan, Vol. 14, No. 3, 360-5 (March, 1959).
A constant-resistance hot-wire anemometer has been nproved to measure velocity fluctuation quantitatively. The effects the resistance of the galvanometer circuit and the current vari- ion due to resistance variation of the hot wire are calculated for e general case. A direct a.c. calibration method, which is easy apply, has been devised. Experiments show that the results otained by this method and the constant-current method completely gree with each other. With possibility of calibration in the actual rcuit, the constant-resistance method would be superior to the onstant-current method.

MOLECULAR THEORY OF GASES

533.7

083. MOLECULAR COLLISIONS IN THE TWO-DIMENSIONAL ASES. K.Takayanagi.
Phys. Soc. Japan, Vol. 13, No. 11, 1405 (Nov., 1958).
The probability of scattering, the scattering cross-section and e phase shifts are derived from the wave-equation. The diffusion oefficient for a binary mixture is also found. R.F.S.Hearmon

533.7 : 534.222.2

13084. MODEL FOR VIBRATIONAL RELAXATION OF DIATOMIC GASES BEHIND SHOCK WAVES. R.Herman and R.J.Rubin.
Phys. of Fluids, Vol. 2, No. 5, 547-50 (Sept.-Oct., 1959).
The problem of the vibrational relaxation of a system of harmonic oscillators is examined for the case in which the oscilla- tors are in contact with a heat bath whose total heat capacity is finite and whose temperature therefore varies during the relaxation pro- cess. An analysis is carried out for processes in which the initial distribution of vibrational energy is a Boltzmann distribution. Appli- cation is made to the vibrational relaxation of a diatomic gas behind a shock wave.

533.7 : 534.22

13085. A DERIVATION OF THE VELOCITY OF SOUND ON THE BASIS OF THE MOLECULAR KINETIC THEORY. V.V.Revenko.
Akust. Zh., Vol. 5, No. 2, 253 (1959). In Russian.
The kinetic theory gives, in a rough approximation, the velocity of sound as the mean velocity of the random motion of molecules (in the direction of propagation of sound) in a unit volume of gas. It is shown that a closer approach to the true value of the velocity of sound may be made by defining the velocity of sound as the mean velocity of the random motion of molecules (in the direction of propagation of sound) which pass through a certain fixed area in the gas. A.Tybulewicz

533.7 : 532.7

MOMENT APPROXIMATIONS IN GENERALIZED BOLTZMANN'S EQUATION. See Abstr. 13063

VIBRATIONS . ACOUSTICS

534.133

13086. THERMOELASTIC LOSS IN QUARTZ VIBRATORS. H.Iwasaki.
J. Radio Res. Lab. (Tokyo), Vol. 5, 257-79 (July, 1958).
A theoretical treatment of the energy dissipation in a quartz vibra- tor, based on a method described by Eshelby (Abstr. 4203 of 1949) leads to an estimate of the thermoelastic loss in 3 common modes of vibration. Expressions are derived for the equivalent R of AT-, X- and $+5^{\circ}$ -cut quartz vibrators, and the numerical constants listed. H.J.H.Starks

534.2

13087. ON "PLASTIC" WAVES IN SOLIDS. J.M.Bowsher.
Canad. J. Phys., Vol. 37, No. 9, 1017-35 (Sept., 1959).
The study of the propagation of "plastic" waves in solids has reached a stage where it is necessary to consider which direction future research should take. In the past 90 or so years many experiments, mostly designed to elucidate certain points of engineer- ing significance, and a few attempts at a theoretical study have cast some light on the subject and revealed it as one of formidable difficulty. Nearly all the experiments have of necessity relied on rather dubious theories for their interpretation, and part of the present paper is devoted to a description of an apparatus which gives results capable of being interpreted with a very mini- mum of theory. The remainder of the paper is devoted to a short review of past work with particular emphasis on basic phenomena and to a brief discussion on the most pressing problems still remaining. The experiments described in the present paper bring to light a factor in the propagation of "plastic" waves that seems to have been overlooked in previous work.

534.2 : 537.528

VACILLATING WAVE RESULTS FROM ELECTRIC FIELD AND POWDER FILLED DIELECTRIC. See Abstr. 13348.

534.21

13088. THE PROPAGATION OF WEAK DISCONTINUITY IN A MULTICOMPONENT MEDIUM. Ya.Z.Kleiman.
Akust. Zh., Vol. 4, No. 3, 253-62 (1958). In Russian.
An equation is derived for determining wave-displacement velocity. In particular, it is established that in the case of different velocities of motion of the components in an N-component medium under defined conditions, waves can be propagated with various velocities, the number of which can vary from 2 up to 2N. The variation of velocity of wave propagation is explained in terms of

the quantitative composition of a 2-component mixture. For the case where the components differ but little in velocity (the case of greatest practical interest) an approximate formula is given for determining the velocity of propagation of a weak discontinuity. [English translation in: Soviet Physics–Acoustics (New York), Vol. 4, No. 3, 258-67 (July-Sept., 1958)]. C.R.S.Manders

534.21 : 534.874.3

13089. MODEL EXPERIMENTS ON SOUND PROPAGATION IN SHALLOW SEAS. A.B.Wood.
J. Acoust. Soc. Amer., Vol. 31, No. 9, 1213-35 (Sept., 1959).

The experiments described deal mainly with the propagation of continuous waves of a particular frequency, and with the variation of signal strength with the depth of the receiver and the water using "point," almost nondirectional transducers. A simple method has been found for lining experimental model scale tanks to make them anechoic at the frequencies considered. It has been demonstrated that temperature changes and surface waves produce marked changes in sound propagation. More important influences, however, appear to be due to the nature of the bottom and the depth of the water. Point-by-point observations indicate that multiple reflections between the water surface and a hard reflecting bottom, like steel or concrete, result in the propagation of many of the higher modes or orders of reflection, and the records of sound intensity variation from surface to bottom at all ranges show numerous maxima and minima. When the bottom is covered with rubber (equivalent to mud and sand), however, the higher modes are suppressed and the records of surface to bottom intensities are much simpler, containing relatively few maxima and minima. All these observations are in reasonable accord with either the mode theory or the ray theory. It has been demonstrated also that the received signal (in all-round transmission and reception) is extremely sensitive to the depth of water. A change of depth of say 5 ft in water of depth 200 ft (full scale) may result in a change of the order of 30 dB in received signal. The distribution of the sound field on the bottom and surface of a water layer has been demonstrated by using sounds of relatively high intensity. Interference patterns form not only on the bottom but also on the surface of the water. A simple "abrasive" method has been devised which provides a permanent record of the sound pattern on the bottom. A new scanning technique has been developed which gives a complete picture of a sound field of relatively low intensity, in a vertical plane either longitudinal or transverse in the water. In this method "point" transducers are used, one of which scans a vertical line several times a second whilst the other travels along or across the tank at a predetermined depth. The received signal modulates the cathode-ray oscilloscope spot which moves up and down in synchronism with the scanning transducer. The scan patterns reveal a striking difference between the two cases of a hard steel (rock) bottom and a rubber covered (mud and sand) bottom. The pattern for a steel bottom is very complex and contains many maxima and minima in each vertical scan. The rubber bottom, on the other hand, provides only a few maxima and minima at each scan. The patterns hitherto obtained are, however, not amenable to mathematical treatment. They confirm and amplify the results obtained by point-to-point methods. This method of scanning should prove a useful tool for further studies of low-intensity sound fields in water.

534.22

13090. SOUND VELOCITY IN WATER ABOVE 212°F.
J.C.McDade, D.R.Pardue, A.L.Heidrich and F.Vrataric.
J. Acoust. Soc. Amer., Vol. 31, No. 10, 1380-3 (Oct., 1959).

The value of sound velocity in water at temperatures above 212°F is needed for the use of acoustic devices, such as flowmeters or level meters, on water at these temperatures. The method consisted of heating water to temperatures above 212°F under pressure; propagating a constant frequency sound signal through it, and using a phase meter to detect changes in wavelength due to changes in sound velocity. The change in sound velocity was computed from the change in wavelength. The value of the sound velocity was obtained by adding the measured change to previously known values below 212°F. It was found that the velocity of sound in water decreases much more than was anticipated from extrapolation methods, at temperatures above 212°F. The measurements show that the sound velocity decreases monotonically from 5066 ft/sec at 210°F to 3230 ft/sec at 550°F.

534.22 : 536.48

THE VELOCITY OF SOUND IN LIQUID HELIUM NEAR THE λ-POINT. See Abstr. 12185

534.22 : 532.

13091. ULTRASONIC VELOCITY AND ADIABATIC COMPRESSIBILITY OF MIXTURE OF SULFURIC ACID AND WATER. Y.Ishida.
J. Phys. Soc. Japan, Vol. 13, No. 5, 536-7 (May, 1958).

The ultrasonic velocity (V) in aqueous solutions of sulphuric acid was measured at a frequency of 5 Mc/s and at temperatures of 15° and 30°C; the density (ρ) was also measured and the compressibility computed as $1/\rho V^2$. The velocity results at 30°C are tabulated and compared with those of Porosorow (1950). A plot of velocity against mole fraction shows a maximum at a mole fraction of sulphuric acid of about 0.2; the compressibilities show a minimum at a mole fraction of about 0.5. R.F.S.Hearmo

534.22 : 533.

VELOCITY OF SOUND IN GASES: KINETIC THEORY. See Abstr. 13085

534.22 : 532.7

13092. ULTRASONIC VELOCITY AND ADIABATIC COMPRESSIBILITY OF MIXTURE OF SULFURIC ACID AND WATE Y.Ishida.
Mem. Coll. Sci. Univ. Kyoto A, Vol. 29, No. 1, 91-105 (Sept., 1958).

An optical method was used for the measurement of the velocity of ultrasonic waves in aqueous solutions of sulphuric acid. At 30°C, the velocity is greatest in 45% solution, but at 15°C, this maximum is found at a higher concentration. Calculation of the adiabatic compressibility gives smaller values at 15°C than at 30°C except for low acid concentrations. It is concluded that the association of water molecules is completely destroyed in aqueous solutions of sulphuric acid whose concentration is smaller than 0.085 mole fraction and 0.11 mole fraction at temperatures of 30° and 15°C, respectively. R.Schnurman

534.222

13093. A METHOD FOR THE DETERMINATION OF THE SHOCK ADIABATIC AND ITS APPLICATION TO METALS. J.Jacquesson.
C.R. Acad. Sci. (Paris), Vol. 249, No. 3, 369-71 (July 20, 1959).
In French.

It is assumed that the conditions down-stream of a shock wave are isentropic and that thermodynamic equilibrium is attained at every instant. From the classical equations for the shock wave, general relations between the pressures, temperatures and speeds are derived and from these relations the shock adiabatic can be obtained without knowing the equation of state. The relations are therefore applicable directly to solids and calculated values of the shock pressure for eight different metallic elements are given. S.Weintrou

534.222.2 : 523.87

13094. EXAMPLES OF EXACT SOLUTIONS OF PROBLEMS OF PROPAGATION OF SHOCK WAVES IN A GRAVITATING GAS FOR ZERO TEMPERATURE GRADIENT. E.V.Ryazanov.
Dokl. Akad. Nauk SSSR, Vol. 126, No. 5, 955-7 (June 11, 1959).
In Russian.

A spherical shock wave expands into a gas. The undisturbed gas in front is at rest in gravitational equilibrium and has density $Ar^{-\omega}$ (A and ω constants). Behind the shock wave the velocity is $2r/3t$ and the density is const. $/t^2$. The heat conductivity is taken as infinite behind the shock. The possible motions are restricted by energy conservation. Assuming a perfect gas, there are three possibilities: (1) $\omega = 5/2$ and γ (specific heat ratio) = 4/3, in which case the energy is constant, except at t = 0 when a finite amount of energy appears at the centre; (2) $30/13 < \omega < 5/2$ and $\gamma = 2(8\omega - 15)/3\omega$, in which case energy is constant throughout; (3) $\omega = 2.65$, $\gamma = 1.55$, in which case energy is also constant. These are suggested as models for certain stellar phenomena. O.Penros

534.222.2 : 541.12

13095. THE CHARACTERISTIC CONDITIONS NEAR THE CENTR OF AN EXPLOSION, GIVING RISE TO TWO SHOCK WAVES. N.N.Kochina.
Dokl. Akad. Nauk SSSR, Vol. 126, No. 6, 1216-19 (June 21, 1959).
In Russian.

A linearized theory of instantaneous explosion in a compressible fluid, developed by the author and Mel'nikova [Prikl. Mat. i Mekh., Vol. 22, 1(1958)], is applied here to the description of resulting shock waves, in terms of temperature and entropy of the mediu J.K.Skwirzynski

534.222.2

096. IMPEDANCE AND SHOCK SPECTRA. G.J.O'Hara.
Acoust. Soc. Amer., Vol. 31, No. 10, 1300-3 (Oct., 1959).

Attempts to combine shock spectra, by envelope of fiducial nit types of analysis, to produce curves useful for design purposes e led to design shock spectra which are extremely overcon- vative. It was noticed that this technique assumes that the pedance of any structure at its foundation for its fixed base natural quencies is very low, and therefore unable to affect the foundation tion. This was in contrast to test evidence that a dip would appear the regions of these frequencies in the spectrum plot. This paper amines the theory of shock spectra, Fourier spectra, and mecha- al impedance to determine qualitatively the effect upon shock ectra of the dynamic reaction of structures. The concept of shock ectrum dip is presented, explained, and experimental verification nibited. Several theorems regarding shock and Fourier spectra e advanced. The necessary distinction between shock spectrum ues at fixed base natural frequencies of a structure and at natural quencies of a structure-foundation combination is demonstrated. e potentially extreme overconservatism in design resulting from correct usage of shock spectra is pointed out.

534.222.2

097. MUTUAL REFLECTION OF TWO SHOCK WAVES OF BITRARY STRENGTHS. W.R.Smith.
ys. of Fluids, Vol. 2, No. 5, 533-41 (Sept.-Oct., 1959).

Experiments were performed in air on the mutual reflection of air of weak shock waves of strength $\xi = 0.915$. The strengths of shock waves were measured interferometrically. The regular lection data agreed with the weak shock regular reflection solu- n for the flow. Regular reflection terminated at the extreme gle α_e, and Mach reflection was found for larger angles. Four s of experiments were performed in air with pairs of mutually re- cting shock waves of unequal strengths. The strengths of these ock waves were also measured interferometrically. The regular a agreed with the weak shock regular reflection solution for the w. Mach reflection was found to occur for angles larger than the reme angle. The experiments failed to resolve any of the diffi- lties concerned with Mach reflection.

534.222.2

098. HEAD-ON COLLISION OF SPHERICAL SHOCK WAVES. Glass and L.E.Heuckroth.
ys. of Fluids, Vol. 2, No. 5, 542-6 (Sept.-Oct., 1959).

Some experimental results are presented of colliding shock ves and the associated spherical flows generated by the blasts m two high-pressure gas spheres. Glass spheres, 2 in. in diam., h their centres located 9 in. apart, containing air or helium up to psi were used to produce the explosions. Instantaneous spark adowgrams, multi-spark schlieren photographs, and wave-speed lieren records of the radius-time plane indicate that this method n be used successfully to study such interactions.

534.222.2 : 541.126

099. TWO CASES OF UNSTABLE COMBUSTION. K.I.Shchelkin.
. eksper. teor. Fiz., Vol. 36, No. 2, 600-6 (1959). In Russian.

A criterion of instability of the combustion zone in a plane tonation wave has been found which determines the conditions for pearance of spin detonation. Conditions are derived for the app- rance of a single-headed spin, many-headed spin detonation and pulsating combustion front in a detonation wave. The applicability the instability criterion (derived by considering a detonation wave) combustion in a forced combustion chamber is demonstrated. ss of stability of a plane combustion zone is treated as the source high frequency flame vibrations. The order of magnitude of the ndamental frequency of the combustion vibration has been deter- ined and the condition of appearance of overtones has been tablished. The origin of resonance vibrations in a furnace is plained qualitatively and the maximal pressure during the vibra- ns is estimated.

534.222.2 : 535.332

RESONANCE RADIATION BEHIND SHOCK WAVES IN Xe.
e Abstr. 13152

534.23

100. CALCULATION SOUND TRANSMISSION THROUGH WALLS Y MEANS OF MATRIX THEORY. Y.T.Wei.
ochfrequenztech. u. ElektAkust., Vol. 67, No. 4-5, 116-20 an., 1959). In German.

Application of matrix methods to the calculation of sound transmission through homogeneous and isotropic layered media at varying angles of incidence. The method is applied to trans- mission through multiple layered walls, the various layers being either in close contact or separated by known thicknesses of air.
A.B.Wood

534.23

13101. ABSORPTION COEFFICIENTS OF A POROUS MATERIAL WITH SLITS. J.Tichy.
Hochfrequenztech. u. ElektAkust., Vol. 67, No. 4-5, 149-53 (Jan., 1959). In German.

The theory is given to derive the specific impedance and sound absorption coefficient of a porous sound-absorbing coating for a wall, the coating being traversed by rectangular grooves or slits of width h, spacing a and depth l, the depth of the absorber below the slits being d. Experiments were made with four different combi- nations h and (a - h).
A.B.Wood

534.23

13102. ULTRASONIC RELAXATION OF THE VIBRATIONAL SPECIFIC HEAT OF CARBON DIOXIDE, SULPHUR HEXAFLUO- RIDE, NITROUS OXIDE, CYCLOPROPANE AND METHYL CHLOR- IDE IN THE LIQUID STATE. R.Bass and J.Lamb.
Proc. Roy. Soc. A, Vol. 247, 168-85 (Sept. 16, 1958).

Measurements have been made of the ultrasonic absorption and the velocity of propagation in a number of liquefied gases at tempera- tures from 0 to 50° C and over the frequency range 1 to 50 Mc/s. The observations in liquid carbon dioxide cover the major part of a relaxation region, centred about a frequency of approximately 10 Mc/s, and a full analysis is therefore possible in this case. The results are adequately described in terms of a relaxation of the total vibrational specific heat associated with a single relaxation time. For sulphur hexafluoride, nitrous oxide, cyclopropane and methyl chloride it was not possible to cover a substantial part of the relaxa- tion region. In each case, however, the results are consistent with the assumption that the observed non-classical absorption is entirely due to vibrational relaxation and that the total vibrational specific heat relaxes with a single relaxation time. The corresponding characteristic frequencies are calculated and fall within the range 60 to 250 Mc/s. Comparisons are made between the values of the product, density (ρ) times relaxation time at constant temperature (τ_T), in the gaseous and liquid states for the above substances and for others, where adequate data is available. It is found that for a given temperature the ratio $(\rho\tau_T)_{liquid}/(\rho\tau_T)_{gas}$ is greater than, but close to, unity. It is concluded that vibrational transitions in liquids which are not highly associated occur by the mechanism of binary collisions between molecules. The quantity $(\rho\tau_T\sqrt{T})^{-1}$, which can be taken as a measure of the collision efficiency, increases with in- creasing temperature for non-polar liquids, but appears to depend very little on temperature for highly polar ones.

534.23

13103. ULTRASONIC INTERFEROMETRY AND THE MEASUREMENT OF THE COEFFICIENT OF ABSORPTION OF LIQUIDS. R.Cerf.
C.R. Acad. Sci. (Paris), Vol. 248, No. 25, 3536-8 (June 22, 1959). In French.

Starting from the Dye equivalent circuit of a piezoelectric resonator, a theoretical expression is derived showing that the inverse of the resistance of the circuit is a linear function of the total decrement of each of the media (quartz, liquid and reflector). This expression forms the basis of a simple method of measuring the coefficient of absorption of a liquid and its practical applications are explored theoretically.
H.J.H.Starks

534.23

13104. THE ABSORPTION OF HIGH INTENSITY ULTRASONIC WAVES IN WATER. V.A.Burov and V.A.Krasil'nikov.
Dokl. Akad. Nauk SSSR, Vol. 124, No. 3, 571-4 (1959). In Russian.

Using apparatus described in an earlier paper (Abstr. 4799 of 1958), measurements were made in distilled water at room temper- atures, at frequencies of 1, 1.5 and 2 Mc/s, and at intensities from 50 to 250 W/cm^2. It is shown that there is maximum absorption at some centimeters from the source. This is accounted for by a distortion of the shape of the ultrasonic wave. The absorption coefficient is roughly proportional to $\sqrt{}$(intensity of source) and to $\sqrt{}$(frequency).
C.R.S.Manders

534.23

13105. ULTRASONIC ATTENUATION IN BISMUTH AT LOW TEMPERATURES. D.H.Reneker.
Phys. Rev., Vol. 115, No. 2, 303-13 (July 15, 1959).

The attenuation was measured at frequencies between 12 and 84 Mc/s for various orientations. The magnetic field dependence of the attenuation at low temperatures exhibits three distinct oscillatory components and a saturation region at fields between 5 and 1600 Oe. A simple interpretation of the salient features of the observations is presented. In particular, the effective mass parameters of the electrons have been determined from the periods of the geometric resonance and de Haas–van Alphen oscillations. A method of measuring the maximum Fermi velocity in a given direction is described, and the results of such a measurement are used to determine an independent value of the Fermi energy. Some data on the temperature and frequency of the zero-field attenuation are included.

534.23

13106. ULTRASONIC ABSORPTION IN METALS. G.L.Kotkin.
Zh. eksper. teor. Fiz., Vol. 36, No. 3, 941-2 (March, 1959). In Russian.

The absorption of transverse sound waves in a transverse magnetic field is considered. A free electron approximation is used and the kinetic equation for the electric field is written down and solved for l (the mean free path) $\gg$ R (the radius of the electron orbit). It is shown that γ (H) (the absorption coefficient) has several maxima, although their positions are not those given by the rules suggested by Pippard and Steinberg (Abstr. 9769 of 1957; 6759 of 1958). M.G.Priestley

534.23 : 539.3

13107. ABSORPTION OF COMPRESSIONAL WAVES IN SOLIDS FROM 100 TO 1000 Mc/sec. J.Lamb, M.Redwood and Z.Shteinshleifer..
Phys. Rev. Letters, Vol. 3, No. 1, 28-9 (July 1, 1959).

A pulse technique is used for measurements in crystal quartz (X-direction of propagation), fused silica, germanium (100 direction), and silicon (111 direction). The absorption is found to be approximately proportional to the square of the frequency (at 20°C), and in silicon to be independent of the dislocation density.

J.Jarzynski

534.232

13108. MOSAIC TRANSDUCER OF BARIUM TITANATE CERAMIC AT ULTRASONIC FREQUENCIES. A.A.Anan'eva.
Akust. Zh., Vol. 5, No. 1, 14-20 (1959). In Russian.

The paper gives the constructional details of a one-side polarized ceramic transducer. The sensitivity figures for the device, both as a receiver and as a transmitter, are given for the frequency range from 40 to 250 kc/s. An experimentally determined frequency characteristic of the transducer is compared with the estimated transmissibility of a multi-layer system equivalent to the multi-layer construction of the given transducer. C.R.S.Manders

534.232

13109. CALCULATION OF THE CONCENTRATION COEFFICIENT OF CERTAIN DIRECTIVE ACOUSTICAL SYSTEMS.
N.F.Vollerner and M.I.Karnovskii.
Akust. Zh., Vol. 5, No. 1, 25-30 (1959). In Russian.

Relationships between the coefficient of axial concentration and the coefficient of pressure amplification of acoustical systems possessing directivity, make it possible to calculate one of these coefficients when the other is known. Such relationships are very useful when direct calculation of one of these coefficients is considerably easier. The authors derive these relationships for axi-symmetrical parabolic and cylindrical concentrators.

A.Tybulewicz

534.232

13110. A METHOD OF SOLVING THE PROBLEM OF RADIATION OF SOUND BY THIN ELASTIC SHELLS AND PLATES.
L.M.Lyamshev.
Akust. Zh., Vol. 5, No. 1, 122-4 (1959). In Russian.

It is required to find the solution of the wave-equation in space surrounding the elastic shell or plate which executes harmonic vibrations under the action of a mechanical force distributed along the shell or plate surface. The required solution may be obtained without discussing the edge conditions if one uses the known solution of the diffraction field of a point source. This solution applies in the space outside the shell or plate. By way of example, the author discusses radiation of sound by a closed spherical shell acted upon by a harmonic force. A.Tybulewicz

534.232 : 538.27

13111. EXCITATION OF HYPERSONIC WAVES BY FERROMAGNETIC RESONANCE. H.Bömmel and K.Dransfeld
Phys. Rev. Letters, Vol. 3, No. 2, 83-4 (July 15, 1959).

The emission of transverse ultrasonic waves from a nickel film deposited on an AC-cut quartz crystal, and excited to ferromagnetic resonance was observed at 1000 Mc/s. The reverse process, the excitation of ferromagnetic resonance by incident ultrasonic waves, was also observed, with the same measured efficiency. The experimental arrangement is described, and the results discussed. S.A.Ah

534

13112. INTERFERENCE AND COHERENCE OF ACOUSTIC SIGNALS. V.V.Furduev.
Akust. Zh., Vol. 5, No. 1, 111-16 (1959). In Russian.

Acoustic interference is observed in speech and music wher two identical signals, separated by a time interval, are superim upon one another. In contrast to optical interference, the resulti acoustic signal changes both in magnitude and sign with time. T changes are described by the author by means of a self-correlat function and an exponential weighting function. Interval of coher of natural vibrations are also discussed. A.Tybule

534

13113. DIFFRACTION OF SURFACE SOUND WAVES ON A SEMI-INFINITE IMPEDANCE TUBE AND ROD. Guan' Din-Khu
Dokl. Akad. Nauk SSSR, Vol. 124, No. 3, 559-62 (1959). In Russi

Although the theory and use of cylindrical aerials of simple construction and high directivity is well established, the strict theory for the acoustic case does not appear to have been worked out. The present author works out the case for the impedance tu by the Wiener–Hopf method. For diffraction at a rod it is shown possible to treat it as a superposition of a surface wave propagat along the outside of a tube and partly inside and of a large numbe of waves propagating inside the tube, which are changed into othe waves at the open end. The conditions governing the choice of th are stated and an infinite system of algebraic equations arises soluble by the method of successive approximations.

C.R.S.Mand

534.39 : 53

13114. EFFECTS OF A PROGRESSIVE ULTRASONIC WAVE O A LIGHT BEAM OF ARBITRARY WIDTH.
L.E.Hargrove, K.L.Zankel and E.A.Hiedemann.
J. Acoust. Soc. Amer., Vol. 31, No. 10, 1366-71 (Oct., 1959).

This study is a theoretical and experimental investigation of effects of a progressive ultrasonic wave on a light beam of smal arbitrary width. Theoretical development of the results given re ly by Zankel (Abstr. 5593 of 1959) is presented. The effects of finite plitude distortion are considered. Measurements of the time-ave intensity distribution in the broadened source slit image are mad for varied light beam widths and sound pressures in water at 1.0 Mc/s and these experimental results are compared with the theoretical results. Previous work of others is discussed in ter of the derived expressions.

534.39 : 54

13115. EFFECT OF ULTRASONIC WAVES ON CONCENTRATI GRADIENTS. R.Penn, E.Yeager and F.Hovorka.
J. Acoust. Soc. Amer., Vol. 31, No. 10, 1372-6 (Oct., 1959).

Schlieren techniques were used to study the effects of ultrasonic waves on concentration gradients produced by electrochem methods. With standing waves at intensities below cavitation le the zones of depleted electrolyte at the cathode stratify at the di placement nodes of the standing waves while the zones of excess electrolyte at the anode stratify at the displacement loops. Thes stratification effects provide an explanation for the ripples prod on the surfaces of metals electrodeposited in standing waves. Microschlieren techniques indicate that ultrasonic waves at cavi tion levels reduce the effective thickness of the diffusion layer a electrode to a value of 10^{-3}cm or less. The mechanism for the ruption of the gradients is believed to involve the microdisturba associated with cavitation bubbles at or near the electrode surfa

534.39 : 537

EFFECTS OF ULTRASOUND ON THE SECONDARY ELECTRON EMISSION OF KCl FILMS. See Abstr. 12363

534.39 : 53

EFFECTS OF 9.2 kMc/s ULTRASONICS ON ELECTRON SP RESONANCES IN QUARTZ. See Abstr. 12472

534

13116. HYDROPHONE MINOR LOBES PRODUCED BY VOLUM SCATTERING. T.G.Bell.

coust. Soc. Amer., Vol. 31, No. 10, 1304-7 (Oct., 1959).
Volume scattering in the ocean determines the lower limit to t can be achieved in a hydrophone's in situ minor lobe response. s paper makes a theoretical examination of the magnitude of nor lobes produced by volume scattering. It is concluded that for irectional hydrophone of moderate-to-high directivity, the ative minor lobe response due to volume scattering is given to a se approximation by the product of the scattering cross-section the distance to source divided by the directivity factor. Direc- of source has a comparatively small effect. Attenuation con- nt may be neglected unless the attenuation loss between source hydrophone is larger than 1 dB or so.

534.417

13117. COMPARISON BETWEEN THE PERFORMANCES OF A ME-AVERAGED PRODUCT ARRAY AND AN INTRACLASS RRELATOR. D.C.Fakley.
Acoust. Soc. Amer., Vol. 31, No. 10, 1307-14 (Oct., 1959).
Berman and Clay (see Abstr. 2911 of 1958) have investigated directional characteristics of a linear array of omnidirectional eiving elements when the output from these elements are multi- ed together and time arranged in certain ways. They conclude t the same directional characteristics may be obtained from se "time-averaged product" (TAP) arrays having a small number detectors as with an additive array with a large number of ele- nts; they also show that there is some economy in terms of the r-all length of the array required to give a specified beam width. ecause it is not possible to assess the characteristics of a TAP ay solely on the basis of its polar diagram, it is necessary to ry out a detailed analysis to determine its usefulness in appli- ions which require a system with a narrow polar diagram. Three ticular applications are investigated, namely the detection of a nt source against a noise background, the resolution of the nals from two closely spaced point sources, and the exploration the distribution of power across an extended source. For com- rison purposes a parallel analysis is carried out for an intra- ss correlation system. For simplicity, the analyses are con- ed to investigating the performance of a 4-element linear array h equal spacings between adjacent elements under elementary and alized conditions. The results so obtained, however, are of neral application. Two class I TAP array systems are compared h the intraclass correlator, the detection performance of which s analysed by Faran and Hills (Acoustics Research Laboratory, rvard University, Techn. Memo. No. 28, Nov., 1952) and which is ieved to be the most "efficient" detector in this application. Class I array is defined as one in which the number of time raging operations lies between $(N-1)$ and $\frac{1}{2}N(N-1)$, where N is number of receiving elements. A class II TAP array, which ploys true multipliers, is obviously inferior to a class I array in ms of detection performance and will not be considered. It has en shown by Melton et al. that a class II type of array employing ncidence detectors rather than multipliers has some useful perties but it can be demonstrated that its detection performance inferior to that of an intraclass correlator. Since class III TAP ays have the same detection performance as the system prior to power and sum circuits there is no need to analyse such arrays e).

534.417

13118. PRESSURE PHONE FOR HYDROPHONE CALIBRATIONS. C.Sims and R.J.Bobber.
Acoust. Soc. Amer., Vol. 31, No. 10, 1315-18 (Oct., 1959).
A small, closed system for the absolute calibration of a ndard hydrophone is described. The method allows control of static pressure and temperatures and is applicable at frequencies to 5 kc/s. The system is designed so that the blocked or Théve- n pressure of the sound source is the same as the sound pressure ing on the hydrophone. The use of a hydrophone, calibrated with pressure phone, as a standard in large closed-chamber systems is cussed.

534.511

13119. SPHERICAL WAVES OF FINITE AMPLITUDE. R.D.Fay.
Acoust. Soc. Amer., Vol. 31, No. 10, 1377-9 (Oct., 1959).
A method is presented for the analysis of spherical waves of finite plitude. An example of the application of the method is given for case of repeated shock waves.

534.612.2

13120. CAPACITANCE-TYPE DISPLACEMENT PROBE. R.D.Shattuck.
J. Acoust. Soc. Amer., Vol. 31, No. 10, 1297-9 (Oct., 1959).
A noncontacting displacement probe is described which is linear throughout the audio-frequency range over a wide displacement amplitude range. The instrument employs commercially available condenser microphone circuitry to measure the displacement of any conducting surface. Entirely conventional audio instrumentation may be employed to analyse test data obtained with the probe. A typical output voltage, with the gauge located 0.1 in.from the vibrating member is 25 mV for a 0.001 in.displacement amplitude. A simple accessory is described for checking the instrumentation sensitivity.

534.614

13121. APPLICATION OF COUNTER-CHRONOGRAPH TECHNIQUE TO MEASUREMENT OF SONIC VELOCITIES. S.Z.R.Hashmi, S.A.Khan and I.Ali.
J. Acoust. Soc. Amer., Vol. 31, No. 10, 1384 (Oct., 1959).
Counter-chronograph technique, familiar in other fields, is applied to the measurement of sonic velocities. The method can also be utilized for nondestructive testing of concrete and other specimens.

534.64

13122. ON THE VARIATION OF ACOUSTIC RADIATION RESISTANCE IN WATER UNDER ULTRASONIC CAVITATION. Y.Kikuchi and H.Shimizu.
J. Acoust. Soc. Amer., Vol. 31, No. 10, 1385-6 (Oct., 1959).
The variation of acoustic radiation resistance of ultrasonic radiation in a cavitating liquid is studied as a function of acoustic intensity and the pulse width of the radiation. Intensities up to 1.75 W/cm^2 are employed and pulse widths down to 3 msec.

534.7

PHYSIOLOGICAL ACOUSTICS. HEARING. See also the Section entitled "BIOPHYSICS. PHYSIOLOGICAL PHYSICS".

534.76

13123. EVALUATION OF STEREOPHONIC LOUDSPEAKER BY MULTIPLE MICROPHONE ARRAYS. R.W Carlisle and A.Schwartz.
J. Acoust. Soc. Amer., Vol. 31, No. 10, 1348-51 (Oct., 1959).
There is a problem in measuring the sound distribution from a stereospeaker array to correlate the results of anechoic chamber measurements with listening tests in live listening rooms. One method which is helpful is to measure the pressure at a large number of points in the live-room. A multiple microphone arrangement is described which facilitates such measurements, and its application to a stereophonic speaker system is illustrated.

534.781

13124. PEAK VU DEFLECTION AND ENERGY FOR MONO-SYLLABIC WORDS. D.M.Green, C.Williams and K.D.Kryter.
J. Acoust. Soc. Amer., Vol. 31, No. 9, 1264-5 (Sept., 1959).
Each word in a recording of two Harvard phonetically balanced (PB) word lists was analysed for peak VU deflection and for energy content using a square law device and voltage integrator. Correlation coefficients between the two measurements are reported.
H.D.Parbrook

534.781

13125. VOWEL OVERLAP AS A FUNCTION OF FUNDAMENTAL FREQUENCY AND DIALECT. R.S.Brubaker and M.W.Altshuler.
J. Acoust. Soc. Amer., Vol. 31, No. 10, 1362-5 (Oct., 1959).
Two groups of young adult male college students spoke the syllables /ʃɛp/ and /ʃæp/ under two conditions which differed in that vowel fundamental was controlled at 130 ± 5 c/s in one condition. One group spoke the General American dialect while the second group spoke a subdialect, that of Altoona, Pennsylvannia. Spectrographic recordings of the utterances were analysed and the centre frequencies of the lower two formants plotted. The plots of the two vowels were analysed and the extent to which they overlapped described. Within the limitations of this study, the results indicate that control of the speaker's vocal fundamental does not reduce vowel overlap, while controlling the subdialect of the speaker does reduce the percentage of overlapping. While overlap is decreased it is not eliminated, and it is probable that vowel discrimination is accomplished by means of cues additional to the frequency locations of the lower formants.

534.784

13126. ON A PECULIARITY OF THE INTELLIGIBILITY OF FORMANTS. M.A.Sapozhkov.
Akust. Zh., Vol. 5, No. 2, 212-14 (1959). In Russian.

Theoretical paper. It is shown that the magnitude of formant intelligibility is determined with reasonable accuracy for practical conditions by the product of the frequency range (in cycles per sec) and the mean value of the effective dynamic range of speech (in decibels). Formant intelligibility is also inversely proportional to the time required for full understanding of the content of the speech.
C.R.S.Manders

534.84

13127. PULSE TECHNIQUE APPLIED TO ACOUSTICAL TESTING. A.C.F.Cho and R.B.Watson.
J. Acoust. Soc. Amer., Vol. 31, No. 10, 1322-6 (Oct., 1959).

The lack of validity of the diffusion assumption makes it desirable to search for further means of assessing the acoustical properties of a room rather than a criterion based solely upon reverberation time. A pulse technique is devised to study transient sound in a room. An electroacoustic system was constructed for generating sound pulses in a room and for receiving and recording the pulses after transmission to various points in the room. Acoustical testing also included the determination of the absorption coefficient of a wall and the tracing of a sound path in a room. A pulse statistical analysis was made to give the r.m.s. deviations of the pulse transient response from the exponential steady state decay based on the known reverberation time. It is concluded that for the lecture room tested a r.m.s. deviation less than 0.50 represents good acoustical conditions for speech.

534.843

13128. THE EFFECT OF THE ROOM SHAPE ON THE SOUND FIELD IN ROOMS (STUDIES ON THE MEASUREMENT OF ABSORPTION COEFFICIENT BY THE REVERBERATION CHAMBER METHOD.I). K.Sato and M.Koyasu.
J. Phys. Soc. Japan, Vol. 14, No. 3, 365-73 (March, 1959).

In order to carry out accurate measurements of the absorption coefficient using the Sabine formula, there must be diffuse distribution of sound energy in the reverberation chamber. Thus, the present work was started from the basic researches of the sound field in the two and three dimensional model rooms. The standing-wave pattern of each normal mode was investigated using dust figures and other methods. At low frequencies, normal mode of vibration existed even when the room shape was made adequately irregular, and for each normal mode, spatial variation of sound pressure did not depend on room shape. However, as the room shape becomes irregular, the nodal lines of successive normal modes distribute at random in space. Also, in the properly irregular room, the variation of decay rate for each normal mode was much smaller than that of a rectangular room.

534.844.2

13129. RANDOM SOUND FIELD IN REVERBERATION CHAMBERS. C.G.Balachandran.
J. Acoust. Soc. Amer., Vol. 31, No. 10, 1319-21 (Oct., 1959).

A series of experiments were performed to compare the efficiency of different diffusing devices in producing a completely random sound field in a reverberation chamber and the effectiveness of some of the methods for judging whether a sound field is completely random. An additional experiment was performed to compare two types of test signal, viz., warble tone and the same nominal band width of random noise. Results of these measurements indicate the general superiority of the rotating vane over other diffusing devices and superiority of random noise over warble tone in producing a smooth decay curve. One of the significant conclusions is that even when the diffusion is reasonably adequate the measured absorption coefficient of a standard sample appears to vary with the chamber absorption especially at the high frequencies.

534.88

13130. USE OF PRESSURE GRADIENT RECEIVERS IN A CORRELATOR RECEIVING SYSTEM. M.J.Jacobson and R.J.Talham.
J. Acoust. Soc. Amer., Vol. 31, No. 10, 1352-62 (Oct., 1959).

An analysis is made of a steerable correlator receiving system which contains two directional receivers of the pressure gradient type. The axes of the receivers are oriented in the broadside direction. The output signal/noise ratio is computed and compared with that of a system employing two omnidirectional receivers. The directional receiver system gives a maximum improvement in output ratio for broadside signal sources which increases as the orders of the receivers increase. The range of improvement over source direction is also studied. Other results include the fact that the maximum output signal noise ratio of the directional receiver system containing two receivers of order 1 (2,3,4, ...) is equal to that of an array system requiring the use of 6 (10,14,18, ...) omnidirectional receivers.

OPTICS . SPECTRA . LUMINESCENCE

535.12 : 530.

13131. GENERALIZED STOKES PARAMETERS FOR WAVES W ARBITRARY FORM. P.Roman.
Nuovo Cimento, Vol. 13, No. 5, 974-82 (Sept. 1, 1959).

The correlation matrix of an arbitrary stationary, quasi-monochromatic electromagnetic radiation field is expanded in ter of nine linearly independent matrices and it is shown that the exp sion coefficients play a role analogous to the customary Stokes parameters.

535.14 : 539.

13132. THE INTERACTION OF LIGHT WITH NEUTRAL SYSTE E.A.Power and R.Shail.
Proc. Cambridge Phil. Soc., Vol. 55, Pt. 1, 87-90 (Jan., 1959).

Theoretical. The analysis of electromagnetic interactions of atoms in Abstr. 8117 (1957) is extended to include magnetic dipol and electric quadrupole moments, and applied to double refractio deriving more directly some results of Abstr. 4906 (1958).
J.Hawg

535.

13133. THE APPLICATION OF AN ELECTRON-OPTICAL IMA INTENSIFIER TO THE PULSE MEASUREMENT OF THE VELOC OF PROPAGATION OF LIGHT. K.S.Vul'fson.
Dokl. Akad. Nauk. SSSR, Vol. 125, No. 6, 1223-4 (April 21, 1959). In Russian.

The author proposes an arrangement for measuring the velocity of light by observing the time interval between the arrival of light pulses reflected from two mirrors placed a known distance apart and illuminated by a suitable source. The source of light would be a pulsed gas discharge and the detector a high-gain ima intensifier with a fast time-base. A time resolution of 10^{-13} sec would be aimed at in the detector.
T.Mulv

535.23 : 53

EMISSIVITY OF MOLTEN METALS. See Abstr. 13215

535.242.41 : 535

PHOTOMETER FOR THE STUDY OF PHOSPHORESCENCE DECAY. See Abstr. 12113

535

13134. THE DISTRIBUTION OF THE SIZES OF IMAGES REFLECTED IN A RANDOM SURFACE. M.S.Longuet-Higgins.
Proc. Cambridge Phil. Soc., Vol. 55, Pt 1, 91-100 (Jan., 1959).

The surface is assumed to have its elevation and all relevant derivatives distributed normally. The distribution of total curvature depends on two parameters and it is shown that one of these can be determined from the distribution of image sizes.
W.T.Welf

535.

13135. THE DEPENDENCE OF THE COMBINED RESOLVING POWER OF AN OBJECTIVE AND A PHOTOGRAPHIC EMULSION ON THE RELATIVE APERTURE OF THE OBJECTIVE. V.Blumová.
Czech. J. Phys., Vol. 8, No. 6, 705-13 (1958). In French.

The resolving power of five objectives was measured using green monochromatic light, a radial resolution chart and two different emulsions. The measurements were made on the axis and in each case the best focus was found. The spherical aberrat of each objective was measured interferometrically. The maxin zonal aberration ranged from 0.1 λ to 0.9 λ and plots of resolving power against relative aperture showed that there were detectabl differences in performance for two lenses when both were stoppe down to have aberrations less than 0.25 λ. The optimum relative aperture for each lens was obtained from the plots. The Strehl definition was also computed for each relative aperture and the results suggested different optimum relative apertures.
W.T.Welf

535.317.5

6.. OPTICAL ABERRATION COEFFICIENTS. V. ON THE LITY OF PREDICTED DISPLACEMENTS. H.A.Buchdahl.
pt. Soc. Amer., Vol. 49, No. 11, 1113-21 (Nov., 1959).
For Pt IV, see Abstr. 8675 (1958). All the primary, secondary, .ertiary aberration coefficients, and the coefficient of quatern- spherical aberration are given for two further systems: wide-angle objective operating at an aperture of f/4.5 and over ld of 70°; and (2) an objective operating at an aperture of f/2.3 a field of 40°. A number of diagrams compare the predicted acements, relative to the ideal image point, of the intersection :s with the ideal image plane of certain selected (a) tangential ils, (b) sagittal pencils, and (c) general skew pencils of rays, the actual displacements as obtained from trigonometrical es. The agreement is very satisfactory. Even in cases, however, nich the agreement — for the largest apertures or fields con- red — leaves something to be desired a knowledge of the coeffi- :s and their derivatives provides a powerful tool for the control the performance of the system. A detailed elementary example trating this assertion is included.

535.321

37. A NEW METHOD OF DETERMINING THE REFRACTIVE EX OF THE EXTRAORDINARY WAVES IN TWINNED UNI- AL NEGATIVE DIELECTRIC CRYSTALS. G.B.Rais.
stallografiya, Vol. 3, No. 1, 101-4 (1958). In Russian.
A theoretical discussion of a method based on the measurement ie angle of incidence corresponding to maximum polarization ie reflected beam. R.F.S.Hearmon

535.323

38. REFRACTIVE INDICES AND TRANSMITTANCES OF ERAL OPTICAL GLASSES IN THE INFRARED.
.Cleek, J.J.Villa and C.H.Hahner.
pt. Soc. Amer., Vol. 49, No. 11, 1090-5 (Nov., 1959).
The refractive indices of 13 optical glasses are reported for the elength range from about 0.43 to 4.25μ. Transmittance data for e thicknesses of the same glasses are given for the wavelength ge from about 1.0 to 5.0μ, along with the calculated absorption fficients.

535.325 : 536.7

REFRACTIVE INDICES OF THE SYSTEM t-BUTANOL–WATER. Abstr. 12194

535.327

39. OPTICAL INVESTIGATION OF SINGLE CRYSTAL LEAD ANATE. E.G.Fesenko and R.V.Kolesova.
stallografiya, Vol. 4, No. 1, 62-4 (1959). In Russian.
Curves are given for the difference between the two principal ractive indices as a function of temperature in two specimens ead titanate, and discussed in relation to domain structure and phase transitions in the material. R.F.S.Hearman

535.33.03 : 539.18

40. A HIGH-INTENSITY ATOMIC-BEAM LIGHT SOURCE. Odintsov.
ka i Spektrosk., Vol. 6, No. 3, 398-404 (March, 1959). In Russian.
Describes a high-intensity light source which uses an atomic n excited by an electron beam. The two beams cross at right- les. Vacuum of the order of 10^{-5}-10^{-6} mm Hg is maintained in apparatus. Observations are made at the point where the two ns meet and the line of observation is at right angles to both ns. The apparatus was tried using cadmium and was found to duce lines of high intensity. A.Tybulewicz

535.33.07

41. ALTERNATING LIGHT METHOD FOR THE DEMONSTRA- N AND MEASUREMENT OF THE LINE-WIDTH OF SODIUM ONANCE LIGHT.
rmbruster, H.Maier-Leibnitz and E.Zimmer.
. Phys. (Leipzig), Folge 7, Vol. 4, No. 1-5, 251-62 (1959).
erman.
If a light beam is passed through a beam of Na atoms, the res of the D lines are absorbed. If the atomic beam is in a gnetic field (H) the light absorbed has the wavelengths of the dis- ed σ-components of the Zeeman pattern of the D lines. By meas- g the absorption for different values of H, the contour of the D s in the source may be determined. Sensitivity is increased by pping the atomic beam and the current from the photomultiplier chronously at 40 c/s. The method is tested with a Na resonance p maintained at various temperatures (122-192°C); measured and calculated half-value widths agree to between 5 and 50%. Self-absorption is a source of error and hyperfine structure is a limitation. The use of the method for the Na lines in the twilight and night sky is considered. G.F.Lothian

535.33.07

13142. INTERFERENCE METHOD FOR CALIBRATION OF RECORDING SPECTROGRAPHS. R.A.Fisher.
J. Opt. Soc. Amer., Vol. 49, No. 11, 1100-4 (Nov., 1959).
A system for the calibration of spectrum records produced by recording spectrographs is described. The method employs as a fiducial scale the recorded interference peaks produced in dispersed white light by a Fabry-Perot etalon and is consequently free of usual systematic calibration errors. Practical details of the method as used for measurements in the infrared with a grating instrument of high resolving power are outlined. Calibration equations are developed for this case and a discussion of factors determining the accuracy of measurement is presented.

535.331

13143. RESONANCE EMISSION BY FINITE VOLUMES. A.M.Samson.
Optika i Spektrosk., Vol. 5, No. 5, 500-10 (1958). In Russian.
Resonance emission by volumes of any shape and size is discussed. An integro-differential equation is obtained, which takes into account the degenerate emission, the effect of thermal background and non-optical excitation. Solution of this equation by the method of successive approximations makes it possible to determine the magnitude of secondary effects and to find the limits of applicability of formulae which neglect the secondary effects. In the majority of cases it is necessary to include the effects of tertiary and higher processes as well. A plane-parallel layer under steady-state conditions is dealt with as a special case. A.Tybulewicz

535.331

13144. THEORY OF THE RESONANCE EMISSION BY A GASEOUS DISCHARGE. B.A.Veklenko.
Optika i Spektrosk., Vol. 6,No. 5, 705-7 (May, 1959). In Russian.
The theory of the resonance emission by a gaseous discharge leads to an integral expression for the distribution of the excited-atom density. This expression was derived by Biberman in 1947 and until now its solution has been obtained by numerical methods. The present note shows that it is possible to obtain the solution of Biberman's equation by finding its extremal functional of the type already used by Marshak (1947) and Su Shu-Huang (1952, 1953). The author applied his method of solving Biberman's equation to a gaseous discharge between two parallel planes and found that his value of the mean time necessary for photons emitted in a certain volume to reach the boundaries of this volume is identical with the effective excited-state lifetime deduced by Biberman. A.Tybulewicz

535.331

13145. THE SELF-BROADENING OF THE Cs LINE 4555 Å. H.Moser and H.Schulz.
Ann. Phys.,(Leipzig), Folge 7, Vol. 4, No. 1-5, 243-50 (1959). In German.
An experimental study is reported of the profiles of the two h.f.s. components of the Cs line ($6S_{1/2} - 7P_{3/2}$) at pressures from 3.8×10^{-5} to 4.6×10^{-3} mm Hg. Corrected for apparatus effects and for Doppler broadening, the two components show the same dependence of line-breadth on density (N), represented by

$$\delta(\lambda) = 1.82 \times 10^{-24} N + 6.18 \times 10^{-11} \pm 1 \times 10^{-11} \text{ cm}.$$

This dependence is considerably greater than predicted theoretically. R.F.Barrow

535.331

13146. TRANSITION PROBABILITIES FOR FORBIDDEN LINES OF Ni II AND Ni III. R.H.Garstang.
Monthly Nat. Roy. Astron. Soc., Vol. 118, No. 3, 234-40 (1958).
These have been computed for magnetic dipole and electric quadrupole radiation for all transitions between levels of the $3d^8$ configuration of Ni III and between the levels of the $3d^84s$ and $3d^9$ configurations of Ni II.

535.331

13147. THE RELATIVE VALUES OF THE f-NUMBERS OF VANADIUM AND COBALT SPECTRAL LINES.
Yu.I.Ostrovskii and N.P.Penkin.
Optika i Spektrosk., Vol. 5, No. 4, 345-53 (1958). In Russian.
The oscillator strengths (the f-numbers) of V I and Co I were obtained using the "hook" method of Rozhdestvenskii. The "hooks"

were photographed for V lines in the 3000-4900 A region at temperatures from 2500 to 2750°K and for Co lines in the 2990-4200 A region at temperatures from 2200 to 2800°K. It was found that the "hook" method was not accurate when levels were further than 1.5 eV from the ground level. A.Tybulewicz

535.331

13148. ISOTOPIC SHIFT IN THE SPECTRUM OF Zr I.
Yu.P.Dontsov.
Optika i Spektrosk., Vol. 6, No. 1, 3-8 (Jan., 1959). In Russian.

A "jump" should occur at N = 50 (N = the number of neutrons in a nucleus) and for this reason the isotopic shift in Zr is of great interest, since one of its isotopes (Zr^{90}) has N = 50. The author excited and recorded the spectra of five samples enriched in Zr^{90}, Zr^{91}, Zr^{92}, Zr^{94} and Zr^{96} respectively. From these the volume parts in the isotopic shifts Zr^{90}-Zr^{92}, Zr^{90}-Zr^{94} and Zr^{94}-Zr^{96} were estimated; the first of these (Zr^{90}-Zr^{92}) confirmed the "jump" at N = 50. A.Tybulewicz

535.331

13149. MULTIPLET SPLITTING OF THE GROUND TERM OF THE HOLMIUM ATOM. V.B.Belyanin.
Optika i Spektrosk. Vol. 15, No. 3, 236-8 (1958). In Russian.
English summary: PB 141047T-7, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

Using the constant difference method, 800 lines of Ho I between wavelengths 3500 and 6000 A were investigated. Three differences, viz: 4664, 4094 and 3782 cm^{-1}, agreeing to within 5% of theoretical calculations, occurred a significant number of times, and it is concluded that the ground term of Ho I $4f^{11}\,6s^2\,{}^4I_{15/2,\ 13/2,\ 11/2,\ 9/2}$ has the values 0, 4664, 8758 and 12541 cm^{-1}. P.A.Young

535.331

13150. LABORATORY WAVE LENGTHS AND INTENSITIES IN THE NEAR INFRARED SPECTRA OF NINE ELEMENTS.
R.A.Fisher, W.C.Knopf, Jr, and F.E.Kinney.
Astrophys. J., Vol. 130, No. 2, 683-7 (Sept., 1959).

The wavelength interval from 1.1 to 2.3 μ was investigated by a grating spectrograph with a lead sulphide detector for lines emmited by laboratory sources in the spectra of iron, nickel, tin, zinc, lanthanum, scandium, potassium, rubidium, and cesium. Measured wavelengths and intensities are reported and, when possible, line classifications. A total of 140 lines is listed for iron and smaller numbers for the other elements, some of which show few measurable lines in the region.

535.332

13151. DESCRIPTION AND ANALYSIS OF THE FIRST SPECTRUM OF IODINE. C.C.Kiess and C.H.Corliss.
J. Res. Nat. Bur. Stand., Vol. 63A, No. 1, 1-18 (July-Aug., 1959).

An extensive survey of the spectra of iodine has led to a list of more than 900 lines emitted by neutral atoms in the region from 23 070 A in the infrared to 1195 A in the extreme ultraviolet. Wavelengths between 12 304 and 2061 A were derived from measurements of spectrograms obtained with gratings of high dispersion. Wavelengths of lines outside these limits are the computed values for lines observed on photometric tracings of the infrared, inaccessible to photography, and in the ultraviolet with a vacuum-grating spectrograph. For many of the lines Zeeman patterns were obtained in a magnetic field of about 37 000 Oe. With these data many of the lines have been classified as combinations between odd levels from the electron configurations $5s^2\,5p^4\,np$ and $5s^2\,5p^4\,nf$, and even levels from the configurations $5s^25p^4ns$ and $5s^25p^4nd$. Among these levels several sets have been recognized as forming Rydberg sequences that are in close agreement in placing the ground state $5p^5\,{}^2P^0_{1\frac{1}{2}}$ of I I at 84 340 cm^{-1} below the ground state $5p^4\,{}^3P_2$ of I II. This gives 10.45 eV for the ionization potential of the neutral iodine atom. A strong infrared line at 13 148.8 A is explained as a magnetic dipole transition between the levels of the ground term $5p^5\,{}^2P^0$.

535.332 : 534.222.2

13152. RESONANCE RADIATION BEHIND SHOCK WAVES IN Xe.
W.Roth.
J. chem. Phys., Vol. 31, No. 3, 844-5 (Sept., 1959).

Simultaneous time-resolved studies are made of the visible continuum and Xe resonance lines 1470 and 1296 A. The emissions commence together. The continuum reaches its maximum earlier and decays quickly due to radiation cooling; slow decay of Xe lines is attributed to imprisonment of resonance radiation. A continuum between 1700 and 1470 A attributed to Xe_2 behaves like the 1470 line. The mechanism of production of the visible continuum is discussed. A.G.Gaydon

535.3

13153. FAR INFRARED SPECTRUM OF HYDRAZINE.
A.Yamaguchi, I.Ichishima, T.Shimanouchi and S.Mizushima.
J. chem. Phys., Vol. 31, No. 3, 843 (Sept., 1959).

The authors have measured the rotation–vibration spectrum of hydrazine in the 260-460 cm^{-1} region using a grating spectrometer. They give results for the rotational constants which support the right-angle model for hydrazine postulated by Penny and Sutherland. D.L.Greenaway

535.337 : 537.311.3

RECOMBINATION EMISSION IN Sb-DOPED Ge. See Abstr. 13297

535.338.3 : 539.1

ON THE SHAPE OF THE LINE PROFILE IN AN ATOMIC BEAM. See Abstr. 13735.

535.34.0

13154. A SIMPLE METHOD OF PREPARATION OF POTASSIUM BROMIDE PLATES FOR INFRARED SPECTROSCOPY OF SOLIDS.
A.I.Finkel'shtein, F.L.Malachevskaya, A.M.Fisher and B.G.Rabovs
Optika i Spektrosk., Vol. 6, No. 3, 415-17 (March, 1959). In Russia

Rectangular KBr or NaCl plates, containing the substance to be investigated (0.1-3%) by infrared spectroscopy, are prepared from dried powders by the application of a 10-15 ton pressure for several seconds (or 5-7 ton for up to 30 min) in a special die. A.Tybulewic

535.343 : 539.

13155. ATOMIC ENERGY LEVELS AND SPECTRA OF NEUTRAL AND SINGLY IONIZED PHOSPHORUS (P I AND P II). W.C.Martin
J. Opt. Soc. Amer., Vol. 49, No. 11, 1071-85 (Nov., 1959).

The spectrum of a hollow-cathode discharge in a mixture of phosphorus vapour and helium has been photographed and measured from 500-10 000 A. This source gave new lines of P II and a much more complete P I spectrum than has hitherto been observed. The P II spectrum of 401 lines is essentially classified by combinations of 38 even and 54 odd levels. Thirty-six of these levels are new, and 29 previously listed levels have been rejected. The $3s^2\,3p\,3d$, 4d, 4p, 4f, and $3s3p^3$ configurations are now complete. Several 5s and 6s levels and most of the expected 5p levels have been found. Except for $3s3p^3$ and $3s^33p.nd$, which show interaction, the configurations are in good agreement with first-order Russell-Saunders theory. The P II ionization potential is 19.72 V. The previous analyses of P I have been revised and extended to include 98 even and 43 odd levels classifying 382 of 490 lines. New terms belonging to the configurations $3s^2\,3p^24$-7s, 4-6p, 3-7d and 4,5f have been fou Wherever feasible, the results have been confronted with the predictions of theory. Several series allow the calculation of a new ionization potential, which is 10.484 V.

535.34

13156. RELATIVE gf-VALUES FOR LINES OF Ca I.
K.H.Olsen, P.M.Routly and R.B.King.
Astrophys. J., Vol. 130, No. 2, 688-92 (Sept., 1959).

Electric-furnace absorption spectrograms were used to derive relative gf-values for 107 lines in 34 multiplets in the spectrum of Ca I. The lines lie in the wavelength region 2990-6720 A and aris from low terms whose excitation potentials range from 0.00 to 2.9 eV. Factors based on the work of other investigators are given, whereby the relative gf-values may be placed on an absolute scale

535.3

13157. CONTRIBUTION TO THE FIRST SPARK SPECTRUM OF GERMANIUM (Ge II). K.L.Andrew and K.W.Meissner.
J. Opt. Soc. Amer., Vol. 49, No. 11, 1086-7 (Nov., 1959).

Observations of the spark spectrum of Ge from 4741 A to 7145 A have made possible the improvement of certain of the term values of Ge II. By combining their interferometric wavelength measurements with some unpublished data, the authors were able t determine the fine structure of four $4s^2nf\,{}^2F^\circ$ terms of Ge II. All the terms for n = 4, 5, 6, and 7 are inverted and the splittings rang from 0.47 to 0.75 cm^{-1}. Values were obtained for the unresolved $4s^2ng\,{}^2G$ terms for n = 6 and 7.

535.34

13158. HYPERFINE STRUCTURE OF THALLIUM^{203} AND THALLIUM^{205} IN THE $7^2S_{1/2}$ STATE. R.J.Hull and H.H.Stroke.
J. Opt. Soc. Amer., Vol. 49, No. 11, 1088-9 (Nov., 1959).

The hyperfine-structure separations in the $7^2S_{1/2}$ state were obtained from the 3776 A resonance line with a grating spectrograp These measurements were carried out because previously quoted valu

lted from a study of the 5350 A transition ending on the $6^2P_{3/2}$ ..., the hyperfine structure of which was inferred to be 8 mk ...i-Kayser; Kayser = 1 cm^{-1}), while recent atomic-beam magnetic-...nance experiments showed $\Delta\nu(6^2P_{3/2}) \cong 17$ mk. The results ...$\Delta\nu(7^2S_{1/2})$ are 405 ± 5 mk and 412 ± 4 mk for Tl^{203} and Tl^{205}, ...ectively.

535.343

9. INFRARED SPECTRUM AT HIGH DISPERSION AND ...ECULAR CONSTANTS OF CO_2. C.P.Courtroy.
... Soc. Sci. Bruxelles I, Vol. 73, No. 1, 5-230 (1959). In French.
The spectrum of CO_2 has been obtained between the photographic ...ared and 3440 cm^{-1}. Ordinary CO_2, and also a mixture with 66% ...was used. Curves and their interpretation are given. More than ... absorption lines have been measured with high precision. They ...grouped into 91 absorption bands of the isotopic forms: $C^{12}O_2^{16}$, ..., $C^{12}O^{16}O^{18}$, $C^{13}O^{16}O^{18}$. A complete analysis has been made for ...and certain results have been obtained for the asymmetric ...ecules. For $C^{13}O_2$ B_0 and B_e are respectively 0.39025 and ... cm^{-1}. D_0 is 13.7×10^{-8} cm^{-1}. The splitting constant ...f II states when Fermi resonance does not occur is represented ...y

$$q_0 = (63 - 1.7\,\nu_3)\,\tfrac{1}{2}\,(\nu_2 + 1) \times 10^{-5}\ cm^{-1}.$$

... perturbation term of Fermi resonance is

$$-(46.52 - 0.10\,\nu_1 - 0.37\,\nu_2 - 0.74\,\nu_3)\,\tfrac{1}{2}\,[(\nu_2 + 2)^2 - l^2]^{1/2}\,\nu_1^{1/2}.$$

R.W.Nicholls

535.343 : 537.312.5

ABSORPTION OF SnS FILMS. See Abstr. 13323

535.343 : 535.37

350. OPTICAL PROPERTIES OF ACTIVATED AND UNACTIVA-...D HEXAGONAL ZnS SINGLE CRYSTALS.
...Keller and G.D.Pettit.
...s. Rev., Vol. 115, No. 3, 526-36 (Aug. 1, 1959).
For previous work, see Abstr. 7972 (1958). Single crystals of ...agonal ZnS, unactivated and activated with Cu, Al, or Mn, were ...mined. The polarization effects in the transmission spectrum ...nactivated ZnS were measured further into the fundamental ...orption than were previously measured. The theoretical pre-...tion that, for direct transitions at k = 0, light polarized perpen-...ular to the c axis is more strongly absorbed than light polarized ...allel to the c axis is born out throughout the fundamental absorp-...n region except in the wavelength region between 290 and 325 mμ. ...wavelength dependence and the polarization of the excitation ...fluorescence spectra of the activated and unactivated crystals ...e measured at room temperature and at 77° K. The excitation ...ctra showed an agreement with the selection rule at the edge of ...fundamental absorption, but there was a reversal of the selection ...e deep in the absorption region. There was also an impurity ...orption exhibiting the same polarization properties as the edge. ...ne fluorescent emissions were polarized perpendicular and some ...e polarized parallel to the c axis. Speculations are made on the ...ersal of the polarization deep in the fundamental absorption and the symmetry and the nature of the sites causing the various ...rescence bands.

535.343

61. VISIBLE AND ULTRAVIOLET ABSORPTION PROPERTIES ...URANIUM DIOXIDE FILMS.
...Ackermann, R.J.Thorn and G.H.Winslow.
...pt. Soc. Amer., Vol. 49, No. 11, 1107-12 (Nov., 1959).
Films of uranium dioxide ranging in thickness from 132 to ... mμ were evaporated on to fused silica, annealed at a pressure ...10^{-6} mm Hg and 960° C, and measured for optical absorption ...ween the wavelengths of 210 and 800 mμ. A moderately intense ...d observed at 240 to 500 mμ has an unsymmetrical shape with a ...ximum at about 318 mμ, an approximately linear part with a ...derate negative slope between 318 and 380 mμ, and a large negative ...pe between 380 and 500 mμ. This band is undoubtedly at least ... unresolved peaks. From 240 mμ to shorter wavelengths there ...a very intense absorption band which is most probably the funda-...ntal band for UO_2. The extinction coefficient was found to vary ...m 0.0055 ± 0.0007 at 650 mμ to a maximum of 0.3702 ± 0.0010 ...360 mμ and to a value of 0.167 ± 0.004 at 240 mμ. The index of ...raction varied from 2.29 ± 0.03 at 800 mμ to a maximum of ...8 ± 0.22 at 450 mμ. The effect of oxidation of the films within ... UO_2 phase suggests that the one unresolved band at 430 mμ is ...moved by oxygen and the one at 300 mμ becomes more intense.

535.343 : 539.2

ABSORPTION BANDS IN NaCl:Ni AND NaCl:Cu.
See Abstr. 12791

535.343

13162. THE OSCILLATOR STRENGTH OF THE γ-SYSTEM OF NO BANDS. S.P.Erkovich.
Optika i Spektrosk., Vol. 6, No. 3, 297-303 (March, 1959). In Russian.
The author used the experimental data of Marmo (Abstr. 3311 of 1954) and Mayence (Abstr. 740 of 1953) to find that the oscillator strength f for the γ-system ($X^2\Pi - A^2\Sigma$ transitions) of NO bands is 0.043. A.Tybulewicz

535.343

13163. THE ROTATIONAL ANALYSIS OF THE BANDS (2,5) AND (2,6) IN THE γ BAND SYSTEM OF THE NO MOLECULE.
E.Koczkás.
Acta phys. Hungar., Vol. 10, No. 1, 117-20 (1959).
Tables of wave-numbers are given for the six branches of each band; these are complete from K = 15 to 33 for the (2,5) band and from K = 7 to 32 for the (2,6) band. Additional values between K = 1 and 44 are also given for most of the branches. P.Young

535.343

13164. INVESTIGATION OF THE ABSORPTION SPECTRUM OF HERAPATHITE CRYSTALS. D.A.Godina and G.P.Faerman.
Optika i Spektrosk., Vol. 5, No. 3, 276-81 (Sept., 1958). In Russian.
English summary: PB 141047T-7, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.
Tables are given of the thicknesses, absorption spectra and polarizations of thin (0.2 to 2.0 μ) flat crystals of herapathite (quinine sulphate polyiodide) containing differing amounts of iodine. Two types are distinguished, "red" and "lilac", the latter containing an excess of free iodine. The wavelength range investigated was from 5600 to 6800 A. See also following abstract. P.A.Young

535.343 : 535.347

13165. ON THE DICHROISM OF CRYSTALLINE IODINE.
D.A.Godina and G.P.Faerman.
Optika i Spektrosk., Vol. 5, No. 3, 282-5 (Sept., 1958). In Russian.
English summary: PB 141047T-7, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.
The absorption spectra and polarizations of iodine crystals ~ 0.5 μ thick were measured throughout the visible spectrum. Due to inability to determine the thicknesses precisely, absolute values of the absorption coefficient could not be given, but it is concluded from a comparison of the transmission of red herapathite (see preceding abstract) and of iodine, that the dichroism of the former is due to oriented iodine molecules within it. P.A.Young

535.343

13166. INFRARED ABSORPTIVITIES AND EMISSIVITIES OF GASES. A.Thomson, W.J.Hooker and S.S.Penner.
J. appl. Phys., Vol. 30, No. 1, 124 (Jan., 1959).
Presents a summary of the more important results of extensive theoretical studies relating to the calculation of the infrared absorptivities and emissivities of gases. Results, extended over an entire vibration–rotation band, have been evaluated for 10 different models. D.L.Greenaway

535.343

13167. RELATION BETWEEN GAS ABSORPTIVITIES AND EMISSIVITIES. D.Olfe and S.S.Penner.
J. appl. Phys., Vol. 30, No. 1, 125 (Jan., 1959).
The results of the preceding abstract have been supplemented by the calculation of the absorptivity of a gas from consideration of the infrared absorption of radiation by molecular vibration–rotation bands composed of randomly distributed dispersion lines with an arbitrary intensity probability distribution function. A comparison of the observed and calculated results for water vapour is given. D.L.Greenaway

535.343

13168. INFRARED STUDIES IN THE 1- TO 15-MICRON REGION TO 30 000 ATMOSPHERES.
C.E.Weir, E.R.Lippincott, A.Van Valkenburg and E.N.Bunting.
J. Res. Nat. Bur. Stand., Vol. 63A, No. 1, 55-62 (July-Aug., 1959).
A pressure cell was constructed using a pair of type II diamonds for study of infrared spectra of solids. Using commercial infrared equipment, spectra can be studied routinely to calculated press-

ures as high as 30 000 atm. Under pressure, bands generally shift to higher frequencies and decrease in intensity. The magnitude of both changes depends on the mode of vibration. Occasionally major changes in spectra occur. In calcite the carbon–oxygen symmetric stretching, mode ν_1, becomes active at elevated pressures while the doubly degenerate ν_3, stretching, and ν_4, bending, frequencies split. From the shift in frequency of ν_1 with pressure the "compressibility", $[(-1/R_0)(dR/dp)]$, of the C–O bond length, R, is calculated to be 2.8×10^{-7} per atm. Major spectral changes are not observed in the same pressure ranges in other carbonates having the calcite or aragonite structures. The results for calcite may be explained by a shift of the $CO_3^=$ ion from the trigonal axis under pressure.

535.343

13169. INFRARED SPECTRA OF SOLUTIONS OF NON-POLAR GASES. J.Jacob.
C.R. Acad. Sci. (Paris), Vol. 249, No. 4, 523-5 (July 27, 1959). In French.

Comparisons have been made of the spectra of three non-polar gases (methane, ethylene and carbon dioxide) in their gaseous states and dissolved in a series of organic solvents. In general, rotational structure disappears in solution; also, the frequency displacements observed for CO_2 indicate that this gas is inert towards both polar and non-polar solvents. D.L.Greenaway

535.343 : 539.19

INFRARED SPECTRUM OF IRON PENTACARBONYL. See Abstr. 12753

535 343 : 539.19

THE MICROWAVE SPECTRUM OF DIMETHYL SILANE. See Abstr. 12739

535.343.9 : 535.375.5

13170. VIBRATION SPECTRUM OF SODIUM NITRITE. A.Tramer.
C.R. Acad. Sci. (Paris), Vol. 248, No. 25, 3546-8 (June 22, 1959). In French.

Gives results for the Raman and infrared spectra of sodium nitrite in the range 120-2700 cm^{-1}. The band strengths, symmetries, and assignments of the observed bands are presented. The effect of polarized radiation incident on oriented single crystal films has been studied, and also, piezoelectric effects observed in certain of the bands are tabulated. D.L.Greenaway

535.343.9 : 535.375.5

13171. RAMAN SPECTRA AND STRUCTURE OF CERTAIN INORGANIC TYPES OF GLASS. Ya.S.Bobovich and T.P.Tulub.
Uspekhi fiz. Nauk, Vol. 66, No. 1, 3-41 (Sept., 1958). In Russian. English translation in : Soviet Physics–Uspekhi (New York), Vol. 66(1) No. 1, 1-28 (Sept.-Oct., 1958).

The Raman spectra, which consist of broad bands, are shown as recordings from a photoelectric instrument; alkali-silicate glasses containing various added oxides — Ge, Ti, Pb, B, Ca,Mg — and crystalline and fused silica are included. These are compared with calculated spectra for simple crystal models. It is concluded that the glasses are structurally inhomogeneous and have a layered structure with a bisilicate composition; fused silica is more similar to quartz than to cristobalite. The literature concerned with the Raman spectra and general structure of glass is extensively reviewed; 83 references. G.F.Lothian

535.345 : 539.19

ABSOLUTE INTENSITY OF THE σ_3 BAND OF CSe_2. See Abstr. 12748

535.345.6 : 522.61

13172. TRANSMISSION OF "CUTOFF" GLASS FILTERS EMPLOYED IN SOLAR RADIATION RESEARCH.
A.K.Angstrom and A.J.Drummond.
J. Opt. Soc. Amer., Vol. 49, No. 11, 1096-9 (Nov., 1959).

The temperature dependence of the wavelength position of the lower sharp cut-off of Schott glass filters and, in particular, the OG1 type is discussed. Generalized relationships are developed to represent the measured filter transmissions. The principal results for the OG1, RG2, and RG8 filters are presented in tabular form.

535.345.6

13173. SPECTROPHOTOMETRIC PROPERTIES OF DISPERSION LIGHT-FILTERS. A.P.Ivanov.
Optika i Spektrosk., Vol. 5, No. 4, 473-7 (1958). In Russian.

Dispersion filters were made by adding powders to binders whose refractive index is the same as the refractive index of the powder at one wavelength only. For this wavelength, the filter medium is optically uniform and light is transmitted through it without loss. Other wavelengths are scattered and are, therefore, considerably weakened after passage through the filter. The present paper reports measurements of transmission, reflection and polarization spectra, and scattering indicatrices of such dispersion filters made of glass powders in methyl benzoate. A.Tybulewi

535.

13174. SCINTILLATIONS FROM LIQUID HELIUM.
E.H.Thorndike and W.J.Shlaer.
Rev. sci. Instrum., Vol. 30, No. 9, 838-9 (Sept., 1959).

Both gaseous and liquid He show scintillations to α-particles from Po^{210}, with the same duration (~ 30-35 mμsec) and about the same light output. S.T.Henders

535.

13175. SPECTROGRAPHIC RESEARCH ON THE TWO LUMINESCENT CENTRES IN CADMIUM IODIDE ACTIVATED WITH LEAD.
G.Monod-Herzen.
C.R. Acad. Sci. (Paris), Vol. 249, No. 2, 251-2 (July 15, 1959). In French.

Absorption measurements on CdI_2 solutions with varying amou of PbI_2 showed the existence of two absorption peaks in the region 330 to 400 mμ. J.Fran

535.3

13176. VARIATION OF THE LUMINESCENCE OF CADMIUM IODIDE ACTIVATED WITH LEAD WITH CONCENTRATION AND TEMPERATURE.
G.Monod Herzen, Nguyen Chung-Tu and H.Mulot.
C. R. Acad. Sci. (Paris), Vol. 249, No. 3, 398-400 (July 20, 1959). In French.

The luminescence intensity of CdI_2 with increasing PbI_2 conten was measured between 25 and 65°C. The intensity increases gradually at low concentrations, more rapidly above a PbI_2 concentration $c = 10^{-3}$, then remains almost constant between $c = 10^{-3}$ and $10^{-0.5}$; at higher concentrations the intensity decreases again. J.Fran

535.

13177. ENERGETIC LIMIT OF THE EFFECTS OF ELECTRO-ENHANCEMENT AND ELECTRO-QUENCHING. G.Destriau.
C.R. Acad. Sci. (Paris), Vol. 249, No. 2, 245-7 (July 15, 1959). In French.

The application of an electric field increases the sensitivity o phosphors of the type CdZns:Mn,X to X-rays, and decreases their sensitivity to u.v. In an intermediate region of excitation, which appears to be situated at about 5000 eV, an electric field will have no effect. J.Fran

535.

13178. ON THE NEW EFFECT OF THE SENSITIZATION TO X-RAYS BY INFRA-RED OF LUMINESCENT PRODUCTS OF THE TYPE CdZnS : Mn, X. F.Pingault.
C.R. Acad. Sci. (Paris), Vol. 249, No. 2, 248-50 (July 15, 1959). In French.

The sensitivity of CdZnS:Mn,X phosphors to X-rays increases on irradiation with infra-red in a similar way as on application of an electric field (see preceding abstr.). Measurements of the emission spectrum under X-irradiation were made with varying intensities of infra-red radiation and field strengths. J.Fran

535.

13179. THE EMISSION CHARACTERISTICS OF CERIUM–SAMARIUM ACTIVATED BORATE PHOSPHORS. H.Witzmann and H.Müller-Buschbaum.
Z. phys., Chem. (Leipzig), Vol. 210, No. 1-2, 72-85 (Jan., 1959). In German.

The samarium emission of calcium borate phosphors is modified by the presence of cerium impurity and by preparation conditions such as firing temperature. A detailed study of the effect of these parameters is made. G.F.J.Garli

535.37 : 539

EXTERNAL QUENCHING, ACTIVATOR INTERACTION, AND WANDERING OF HOLES IN THE ZnS:Cu AND ZnS:Cu,Co PHOSPHORS. See Abstr. 12801

535.3

13180. TEMPERATURE QUENCHING OF FLUORESCENCE.
V.V.Zelinskii, V.P.Kolobkov and N.D.Krasnitskaya.
Optika i Spektrosk., Vol. 6, No. 3, 417-19 (March, 1959). In Russi

The fluorescence yield increases in some substances at low

nperatures. On a particular example of certain phthalimide and .inomaleinimide derivatives it is shown that, apart from "freez-;" of the motion of various parts of a fluorescent molecule, this :rease is due to weaker temperature quenching (redistribution molecules at the excited vibrational levels), as well as to changes the mutual positions of the potentials of the ground and excited ıtes of the molecule which occur on lowering of temperature.
A.Tybulewicz

535.37 : 539.1.07
HIGH-LEVEL DOSIMETRY BY LUMINESCENCE DEGRADATION. e Abstr. 13521

535.37
181. FLUORESCENCE SPECTRA IN SOLUTIONS RYSTALLIZED AT 77°K. L.Pesteil and A.Ciais.
R.Acad. Sci. (Paris), Vol. 249, No. 4, 528-30 (July 27, 1959). French.
The fluorescence spectra of naphthalene, acenaphthene and rene in n-pentane are shown diagrammatically for a range of ncentrations. With increasing concentration some lines disappear t some persist. S.T.Henderson

535.37
182. FLUORESCENCE DECAY TIMES IN Tl-ACTIVATED ORGANIC SCINTILLATORS FOR PARTICLES OF DIFFERENT ONIZING POWER. M.Bormann, G.Andersson-Lindström, .Neuert and H.Pollehn.
Naturforsch., Vol. 14a, No. 7, 681-3 (July, 1959). In German.
The rise time of scintillation pulses is shown to depend on the pe of exciting particle, being shorter for heavily ionizing particles. ne effect is greatest for CsI-Tl and NaI-Tl. G.F.J.Garlick

535.37
3183. ON THE NON-EXISTENCE OF AN EXCITATION HRESHOLD IN ELECTROLUMINESCENCE.
.Destriau and L.Doumergue.
emiconductors and phosphors (see Abstr. 9597 of 1959) pp. 544-6. German.
An electroluminescent cell gave light emission detected by a otomultiplier and d.c. amplifier. The minimum luminance meas-red was $\sim 7 \times 10^{-8}$ cd/m^2, or 1/100 of the threshold of the dark-lapted eye, but no indication of a lower limit to the light output as observed as the potential applied to the cell was reduced. S.T.Henderson

535.37 : 621.383.2
3184. PROBLEMS OF P–N ELECTROLUMINESCENCE IN THE ISIBLE SPECTRAL REGION. A.Fischer.
emiconductors and phosphors (See Abstr. 9597 of 1959) pp. 551-3. German.
Among compounds of high forbidden band gap and low ionic haracter, including BP, AlN, ZnSe and CuI, many show electro-minescence by collision ionization, but only SiC has emission in e visible region produced at p–n junctions. S.T.Henderson

535.37
3185. PHASE CORRELATION OF SOUND PRESSURE AND ONOLUMINESCENCE. P.Günther, E.Heim and G.Eichkorn.
angew. Phys., Vol. 11, No. 7, 274-7 (July, 1959). In German.
Agreement in phase between sonoluminescence emission and ound pressure peak is found. The assumption of an adiabatic ompression of the gas in cavities as a cause of the emission is ven further support by this result. G.F.J.Garlick

535.39 : 536.3
186. MEASUREMENT OF REFLECTANCE AND EMISSIVITY F GRAPHITE AT ARC TEMPERATURE WITH A CARBON ARC MAGE FURNACE. M.R.Null and W.W.Lozier.
appl. Phys., Vol. 29, No. 11, 1605 (Nov., 1958).
The radiation from the image furnace is allowed to fall on the udy sample and a measurement made of the reflected fraction. ne sample can be the crater surface of another arc and this allows e emissivity and the true temperature of the arc to be calculated. ractical details of the apparatus are given and a typical result is ioted. R.W.Fish

535.39 : 541.182.4
REFLECTION DETERMINATION OF SURFACE AVERAGE ARTICLE DIAMETER OF COLOURED EMULSIONS.
ee Abstr. 12854

535.39 : 537.312.5
OPTICAL PROPERTIES OF THIN PHOTOCONDUCTIVE LAYERS. See Abstr. 12288

535.39 : 525.3 : 536.3
SiO FILM ON Al FOR TEMPERATURE STABILIZATION OF EARTH SATELLITE. See Abstr. 13216

535.392
13187. THE FAR INFRARED REFLECTIVITY OF NaCl, KCl, AND KBr CRYSTALS. A.Mitsuishi, H.Yoshinaga and S.Fujita.
J. Phys. Soc. Japan, Vol. 14, No. 1, 110 (Jan., 1959).
Reflectivity curves have been obtained in the 30-100 μ region using angles of incidence of 12° and 52°. No reflection peaks were observed between 100 and 200 μ. D.L.Greenaway

535.393 : 537.226.1
POLARIMETRIC STUDY OF VERY THIN DIELECTRIC SURFACE LAYERS. See Abstr. 13243

535.399
13188. OPTICAL ANISOTROPY AND PROPERTIES OF CADMIUM SULPHIDE SINGLE CRYSTALS IN HIGH-FREQUENCY FIELDS. A.Bartschat and H.Gobrecht.
Semiconductors and phosphors (see Abstr. 9597 of 1959) pp. 622-9. In German.
Experimental results are reported for the dispersion curves of the ordinary and extraordinary rays in CdS at room and liquid air temperatures. Further experiments show that high frequency fields can increase the photoconduction in CdS single crystals. C.A.Hogarth

535.41 : 539.18
CALCIUM ATOMIC BEAM SOURCE AND INTERFERENCE BEYOND TWO METRE RETARDATION. See Abstr. 12731

535.417
13189. TRIANGULAR PATH MACRO-INTERFEROMETER. P.Hariharan and D.Sen.
J. Opt. Soc. Amer., Vol. 49, No. 11, 1105-6 (Nov., 1959).
A triangular-path shearing interferometer is described which can be used for the examination of large transparent objects. It has the advantage that it can be conveniently adapted to an existing schlieren system, affording the possibility of quantitative measurements. The additional optical elements required are only of comparatively small aperture and are therefore quite inexpensive.

535.417 : 531.715
13190. INTERFEROMETRIC CALIBRATION OF QUARTZ END STANDARDS. E.Engelhard.
Z. InstrumKde, Vol. 67, No. 3, 59-65 (March, 1959). In German.
A review is given of the interference methods in use in different countries for the testing and preparation of end standards. The definition of the official metre is discussed. It is considered that the uncertainty in the best cases approximates to 0.1 μ. It is estimated that a five times smaller uncertainty could be attained by using the red cadmium wavelength as the standard instead of the standard metre. A ten times smaller uncertainty is attainable using Kr^{86}. S.Tolansky

535.42
13191. DIFFRACTION THEORY OF ABERRATIONS. B.Schnabel.
Optik, Vol. 16, No. 8, 449-56 (Aug., 1959). In German.
The work of Nijboer and Zernike and of Slevogt on the diffraction images of point sources is criticized as being valid only for small relative apertures and field angles. In order to remove these restrictions it is proposed to integrate over a plane circular pupil normal to the optical axis. For off-axis image points this leads to a double Neumann series in which the coefficients are integrals over the pupil area. No special cases are worked out. An extension of the method to deal with vignetting by circular apertures is indicated. W.T.Welford

535.43 : 535.89
13192. A LOW-PRESSURE MERCURY ARC FOR STUDY OF LIGHT SCATTERING. M.L.Sosinskii.
Optika i Spektrosk., Vol. 6, No. 3, 405-11 (March, 1959). In Russian.
Three types of low-pressure water-cooled mercury arc lamps are described. These lamps emit narrow lines, have low continuous background and low intensity of unwanted 4348 and 4339 A lines A.Tybulewicz

535.43

13193. OPTICAL CONDITIONS INSIDE A SCATTERING MEDIUM AND SPECTROSCOPY OF DISPERSE SUBSTANCES.
G.V.Rozenberg.
Dokl. Akad. Nauk SSSR, Vol. 122, No. 2, 211-14 (Sept. 11, 1958). In Russian.

The author supplies a theoretical basis for Timofeeva's (Abstr. 589 of 1958) empirical relationships governing the conditions deep inside a scattering medium. A homogeneous isotropic medium is considered and polarization effects are allowed for by the use of the Stokes vector-parameter. Spectroscopy of scattering media is discussed; it is pointed out that the absorption (α) and scattering (σ) coefficients of a disperse substance can be obtained separately when $\alpha/\sigma > \sim 1$ (by reflectivity measurements) and when $\alpha/\sigma \ll 1$.
A.Tybulewicz

535.43

13194. CONTRIBUTION TO THE THEORY OF SCATTERING OF LIGHT NEAR PHASE TRANSITION POINTS OF THE SECOND KIND.
A.P.Levanyuk.
Zh. eksper. teor. Fiz., Vol. 36, No. 3, 810-18 (1959). In Russian.

Formulae for the intensity of scattered light near transition points were derived on the basis of the exact Gibbs expression for fluctuations of the parameter characterizing the phase transition of the second kind. The formulae are employed to estimate the minimal width of the temperature region near a transition point at which the usual macroscopic theory of phase transitions of the second kind becomes meaningless. The formulae are also used to substantiate the validity of the calculations of the scattered light intensity by Genzburg and Levanyuk (Abstr. 8004 of 1959).

535.43 : 539.2

THE SCATTERING OF LIGHT BY NaCl CRYSTALS. See Abstr. 13795

535.43 : 534.39

EFFECTS OF A PROGRESSIVE ULTRASONIC WAVE ON A LIGHT BEAM OF ARBITRARY WIDTH. See Abstr. 13114

535.56

13195. THEORY OF THE OPTICAL ACTIVITY OF CRYSTALS. I. THE LAW OF CONSERVATION OF ENERGY AND OPTICAL ACTIVITY TENSORS. F.I.Fedorov.
Optika i Spektrosk., Vol. 6, No. 1, 85-93 (Jan., 1959). In Russian.

A phenomenological theory of the optical activity of crystals is given in an invariant form, which is independent of coordinates. It is found that optical activity tensors become zero in crystals of all central and planaxial classes (there are 11 of them) which possess inversion symmetry. These tensors are also equal to zero in two other classes of crystals: those with hexagonal syngony (with sixth-order inversion axis) and the planar crystals of cubic syngony. Optical activity is possible in the remaining 18 classes of crystal symmetry.
A.Tybulewicz

535.56

13196. THEORY OF OPTICAL ACTIVITY OF CRYSTALS. II. CRYSTALS OF CUBIC SYNGONY AND PLANAR CLASSES OF MIDDLE SYNGONIES. F.I.Fedorov.
Optika i Spektrosk., Vol. 6, No. 3, 377-83 (March, 1959). In Russian.

Discusses propagation of light in anisotropic media with the highest symmetry, i.e. in crystals of cubic syngony and planar classes of middle syngonies. As in Pt I, invariant treatment is employed. It is found that in planar classes of middle syngonies there is no rotation of the plane of polarization on propagation of light along the optical axes. Nevertheless properties of such crystals differ essentially from properties of optically inactive crystals, since the light reflected at such crystals is elliptically polarized. It is pointed out that optically active substances do not necessarily exhibit the property of rotation of the plane of polarization and proposes that a medium should be called optically active if its constitutive equations have the form

$$\vec{D} = \epsilon\vec{E} + [\alpha\nabla,\vec{E}], \quad \vec{B} = \mu\vec{H} + [\beta\nabla,\vec{H}]$$

where α and β are the electric and magnetic optical-activity tensors respectively. From this definition it follows that a medium which rotates the plane of polarization for one or more directions of propagation of light is necessarily an optically active medium, but, in general, the converse is not true.
A.Tybulewicz

535.56

13197. THEORY OF THE OPTICAL ACTIVITY OF CRYSTALS. III. THE GENERAL EQUATION OF NORMALS.
B.V.Bokut' and F.I.Fedorov.
Optika i Spektrosk., Vol. 6, No. 4, 537-41 (April, 1959). In Russian.

Deals with the general equation of normals for the optically active crystals when magnetic effects are allowed for. The theory shows that three types of waves are possible in optically active crystals, and the phase velocity of the third wave should be very small compared with the velocity of light.
A.Tybulewicz

535 56

13198. A PHOTOELECTRIC SPECTRO-POLARIMETER FOR THE STUDY OF THE DISPERSION OF NATURAL ROTARY POWER.
M.Billardon and J.Badoz.
C.R. Acad. Sci. (Paris), Vol. 248, No. 17, 2466-8 (April 27, 1959). In French.

The principle of the instrument is described. The Faraday effect is used to compensate the rotation so that the method is a null method and a linear mode of detection is employed. [See Abstr. 2093, 3182, 5258 of 1957 and Breton, J. Phys. Radium, Suppl. No. 11 53S (Nov., 1957)]. Angles of rotation of the order of 0.5° can be measured to about 10^{-3} degrees in the visible and near ultraviolet. The rotary dispersion curve for the trioxalate of rhodium and potassium, which has an absorption band at 4300 A, is determined for the wavelength range 3550 to 5900 A.
H.G.Jerrard

535.6 : 621.397.3

13199. INTERNATIONAL SYMPOSIUM. PHYSICAL PROBLEMS OF COLOUR TELEVISION.
Acta electronica, Vol. 2, No. 1-2, 1-419 (1957).

For abstracts of some of the papers read at the above Conference, see Abstr. 5480-3, 5487, 5596, 5599, 6406-6408, 6411-15, 6679-82, 7701, 7926, 9121, 9369-70, 9536, 10461 (1959).

535.65 : 621.321

13200. METHOD OF EXPRESSING THE COLOUR-RENDERING PROPERTIES OF A LIGHT SOURCE BY REFERENCE TO THE BLACK BODY WITH THE CLOSEST SPECTRAL LIGHT DISTRIBUTION. K.Larché and H.Schlegel.
Tech. wiss. Abhandl. Osram-Gesell., Vol. 7, 331-6 (1958). In German.

After a review of various proposals for expressing colour-rendering concisely, a method is described in which the light emitted in selected spectral bands is compared with that given by a black body in the same bands. The r.m.s. value of the differences is found and this quantity is plotted for a series of temperatures of the black body. The temperature at which the r.m.s. value is a minimum is used to express the colour-rendering of the light. This temperature is usually different from that at which the nearest visual match is found.
J.W.T.Walsh

535.6

13201. FLUORESCENCE AND GRAY CONTENT OF SURFACE COLORS. R.M.Evans.
J. Opt. Soc. Amer., Vol. 49, No. 11, 1049-59 (Nov., 1959).

An investigation of the colours in the Munsell 5R plane and an extension of this study to colours produced in a small aperture in a large white illuminated surround have led to the discovery of some interesting and novel relationships. It is found that under these conditions the domain of surface colour perception includes the whole of the range from V = 0 to 10 and p_c = 0 to 1.0 and under some conditions more. For a colour of a given dominant wavelength there is a locus lying wholly within this space along which lie colours that do not appear to contain grey. If luminance or purity is increased above a point on this line, the sample takes on the appearance characteristic of a fluorescent material. If either is decreased below a point on this line, the colour is perceived as having a grey component added to the purely chromatic component in increasing amounts until at $p_c = 0$, there is no chromatic component perception of the colour or at low values of V the sample appears black. Above a point somewhat higher than surround luminance, the appearance of fluorescence ceases and the surface mode changes to the illuminant mode, the saturation of the perceived colour decreasing with increasing luminance above this point. An hypothesis is suggested to explain the facts and it is pointed out that more than one kind of "brightness" is necessarily involved.

535.7

PHYSIOLOGICAL OPTICS. VISION. See also the Section entitled "BIOPHYSICS. PHYSIOLOGICAL PHYSICS".

535.81

1 02. THE INFLUENCE OF POLISH DEFECTS OF OPTICAL S RFACES ON THE CONTRAST TRANSFER FUNCTION. E iederichs and A.Lohmann.
C ik, Vol. 15, No. 12, 751-7 (Dec., 1958). In German.

The defects are assumed to be randomly distributed and small n lepth compared to λ. Under these conditions the total transfer f ction of a system is expressed as a product of two functions, one f the ordinary aberrations and the other for the polish defects. F r sufficiently large spatial frequencies the latter depends only o the mean depth of the defects. W.T.Welford

535.81 : 531.719.2

REFRACTION NEAR THE EARTH'S SURFACE AND OPTICAL T TANCE-MEASUREMENT. See Abstr. 13048

535.822 : 778.33

COMPARATIVE MERITS OF DIFFERENT METHODS OF M CRORADIOGRAPHY. See Abstr. 12929

535.89

1 03. EMISSION FROM A POWERFUL PULSE LAMP AT THE M MENT OF EXPLOSION. I.M.Gurevich.
C ika i Spektrosk, Vol. 4, No. 2, 252-3 (Feb., 1958). In Russian. E glish summary: PB 141047T-1, obtainable from Office of Tech- n al Services, U.S. Dept. of Commerce, Washington,D.C., U.S.A.

A pulse photometer oscillogram, obtained at the moment when a ulse lamp unexpectedly exploded, showed that 0.3 msec after r ching a maximum the intensity increased again, whereas normally, t first maximum only was observed. The second maximum was a sumed to be due to the rapid evaporation of quartz from the walls o the lamp; the author has carried out experiments with pulse dis- c arges in quartz capillaries and obtained extremely high intensities. R.D.Hudson

535.89 : 535.43

A LOW-PRESSURE MERCURY ARC FOR STUDY OF LIGHT S ATTERING. See Abstr. 13192

HEAT

536.2

1204. TWO EXACT SOLUTIONS TO THE NONLINEAR STEFAN R OBLEM. G.A.Tirskii.
D kl. Akad. Nauk SSSR, Vol. 125, No. 2, 293-6 (1959). In Russian.

The nonlinear Stefan problem is posed by:

$$N(\theta)\frac{\partial\theta}{\partial t} = \chi\frac{\partial}{\partial y}\left[L(\theta)\frac{\partial\theta}{\partial y}\right]$$

r y, t > 0 and $\theta(y, 0) = 0$; $\theta(0, t) = 1$; $\frac{\partial\theta}{\partial y} \to 0$, as $\theta \to 0$ and/or as $y \to \infty$.

n ctional conditions on $L(\theta)$ are discussed and it is shown that two d dependent sets of conditions for which exact solutions exist may be p stulated. Application to nonlinear, non-stationary heat-flow prob- l ms is briefly considered. J.W.Gardner

536.21

1205. PLANE NON-STATIONARY PROBLEM OF THERMAL C NDUCTION FOR A SEMI-BOUNDED BODY WITH INTERNAL C OTHERMAL CYLINDRICAL HEAT SOURCE. I.A.Ioffe.
Z. tekh. Fiz., Vol. 29, No. 3, 417-22, (March, 1959). In Russian.

The time-dependent integral equation of heat flow is solved by a m thod of images. An image source—sink is postulated, which is s e reflection of the original in the infinite plane boundary of the m dium, and which preserves the continuity conditions at the b undary. The integral kernel is now a symmetric combination of B ssel functions and simplifies considerably. J.W.Gardner

536.21 : 548

1206. HIGH-TEMPERATURE THERMAL CONDUCTIVITY OF I SULATING CRYSTALS: RELATIONSHIP TO THE MELTING P INT. R.W.Keyes.
Phys. Rev., Vol. 115, No. 3, 564-7 (Aug. 1, 1959).

The Lindemann melting rule is used to eliminate the elastic c nstant from the thermal conductivity formula proposed by Lawson [J. Phys. Chem. Solids, Vol. 3, 154 (1957)]. The thermal conductiv- i y is thus obtained as function of density, atomic weight, and melting t mperature. The introduction of a dependence on bond character a lows a major fraction of the available high-temperature thermal c nductivity data to be reproduced within a factor of 2. A dependence of thermal conductivity on mass ratio of the type found theoretically by Blackman for diatomic crystals is observed.

536.21 : 537.323

HEAT CONDUCTION OF III-V COMPOUNDS AND THEIR MIXED CRYSTALS. See Abstr. 12314

536.212 : 537.323

THERMAL CONDUCTIVITY OF Bi_2Se_3. See Abstr. 12315

536.21 : 537.311.3 : 539.2

ELECTRICAL AND THERMAL RESISTIVITY OF DISLOCATIONS. See Abstr. 12770

536.212.2

13207. THE CALCULATION OF THE THERMAL CONDUCTIVITY OF DISORDERED STRUCTURES. J.Tavernier.
C.R. Acad. Sci. (Paris), Vol. 248, No. 24, 3427-9 (June 15, 1959). In French.

See Abstr. 2262 (1959). A phenomenological study in which it is shown that the thermal conductivity K of a crystal of a disordered structure lies between the contributions K_l and K_t from the longitudinal and transverse phonons respectively. Expressions for K_l and K_t in terms of the temperature and the melting point of the crystal and the mean mass of the atoms are obtained. These are in agreement with calculated values from known data for a number of insulators. The K_l contribution would seem to be predominant. S.Weintroub

536.212.2 : 537.312.62

13208. THERMAL CONDUCTION OF SUPERCONDUCTORS. B.T.Geilikman.
Zh. eksper. teor. Fiz., Vol. 34, No. 4, 1042-4 (April, 1958). In Russian. English translation in: Soviet Physics—JETP (New York), Vol. 34(7), No. 4, 721-2 (Oct., 1958).

Starting from the B.C.S.—Bogoliubov theory, an expression is derived for the electronic contribution to the conductivity at temperatures well below T_c, where elastic scattering by impurities is predominant. It is shown that the "convection" contribution to the conductivity is always negligible. R.G.Chambers

536.212.2 : 537.311.1

THERMAL CONDUCTIVITY OF MONOVALENT METALS: EFFECT OF COULOMB INTERACTION. See Abstr. 12232

536.212.3

13209. THERMAL CONDUCTIVITY OF $BaTiO_3$ CERAMICS. I.Yoshida, S.Nomura and S.Sawada.
J. Phys. Soc. Japan, Vol. 13, No. 12, 1550-1 (Dec., 1958).

The thermal conductivity of ceramic $BaTiO_3$ has a negative temperature coefficient, but does not follow the 1/T law required by the phonon theory and has a small hump at the Curie point. $PbTiO_3$ behaves similarly, but $SrTiO_3$ has nearly double the thermal conductivity. Apparently the thermal vibrations of the ions are affected by the displacements which produce ferroelectricity. R.C.Kell

536.23

13210. HEAT TRANSFER IN RAREFIED GASES. I-II. T.Fujimoto and K.Takao.
Bull. Japan Soc. Mech. Engrs., Vol. 2, No. 6, 197-204, 204-9 (May, 1959).

In Pt I, starting from the Maxwell—Boltzmann equation for the molecular velocity distribution function, the problem of steady one-dimensional heat transfer in a rarefied gas is treated mathematically. The temperature distribution between the plates, and the relation between the temperature difference between the plates and the heat flux, are obtained. The velocity distribution function has to be divided into separate functions for the incident and reflected molecules, respectively, and in all seven equations have to be solved. In Pt II, a description is given of an experiment carried out to measure the coefficient of heat transfer between brass plates in order to determine values for the constants appearing in the expression for the temperature distribution obtained in Pt I. The high temperature plate consisted of a transiently heated Ni—Cr wire sandwiched between, but electrically insulted from, two brass plates, and it was placed between, but separated from, two larger parallel brass plates which constituted the low temperature plates. The temperatures were measured by thermocouples, and the pressure ($10^{-1} \sim 10^{-4}$ mm Hg) in the bell-jar container by McLeod and Pirani gauges. The results are shown graphically. S.Weintroub

536.23

13211. THE HEAT TRANSPORT IN QUARTZ POWDER–GAS MIXTURES, A METHOD FOR THE DETERMINATION OF THE THERMAL CONDUCTIVITY OF GASES AT HIGH TEMPERATURES.
K.Schäfer and K.-H.Gründler.
Z. Elektrochem., Vol. 63, No. 4, 449-53 (1959). In German.

The hot-wire method was used to obtain the thermal conductivity λ_M (relative to that of A) of a quartz powder between 0° and 300°C when mixed with Xe, Kr, A, SO_2 or CO_2, and at 0°C when mixed with O_2, N_2 and C_2H_6. The apparatus is described, and the results are shown graphically and tabulated. λ_M appears to be independent of pressure. It is shown that λ_M and λ_G for the pure gas are linearly related. S.Weintroub

536.24 : 532.54

13212. HEAT TRANSFER IN THE VISCOUS–GRAVITATIONAL RANGE OF THE FLOW OF A LIQUID IN A RECTANGULAR CHANNEL. N.V.Tsarenko.
Scientia Sinica, Vol. 8, No. 7, 690-9 (July, 1959). In Russian.

The term "viscous–gravitational flow" denotes streamline flow whereby free convection of heat is superposed on forced convection. Experiments were made in which a liquid is flowing through a vertical or horizontal tube of rectangular cross-section. Measurements were made of the heat exchange between the liquid and the walls of the tube. The results are presented in the form of graphs showing the dependance of the heat transfer coefficient upon the rate of flow in terms of dimensionless quantities. R.Eisenschitz

536.24 : 539.17

HEAT TRANSFER TO WATER IN ROUGH PIPES.
See Abstr. 12708

536.24 : 539.17

TIME DEPENDENCE OF HEAT TRANSFER FROM FUEL ELEMENTS. See Abstr. 12709

536.27 : 532.25

13213. ON THE THERMAL INSTABILITY OF A ROTATING FLUID SPHERE. F.E.Bisshopp.
Phil. Mag. (Eighth Ser.), Vol. 3, 1342-60 (Dec., 1958).

The problem of the thermal instability of a self-gravitating rotating fluid sphere of constant density with internal heating is treated. A method of solving this problem is described which correctly takes into account the full set of boundary conditions. The cases when the bounding sphere is rigid and when it is free are both treated. The Rayleigh–Ritz method of approximating lowest characteristic values is used in a variation principle presented by Chandrasekhar to calculate the critical Rayleigh number as a function of the Taylor number.

536.3

13214. SOME PROBLEMS IN THE THEORY OF RADIATIVE EXCHANGE AND TRANSFER OF HEAT IN ABSORBING MEDIA.
Yu.A.Surinov.
Dokl. Akad. Nauk SSSR, Vol. 123, No. 5, 813-16 (1958). In Russian.

A nonlinear integral equation for heat exchange between partly absorbing bodies, submerged in moving, heat absorbing medium, containing also point sources, was constructed previously by the author. Here, an iterative method of solution is indicated for mixed boundary conditions and the uniqueness of such a solution is discussed. A correction for energy dissipation is also included, although the basic formulation of the problem concerns only stationary systems. J.K.Skwirzynski

536.3 : 535.23

13215. THE EMISSIVITY OF MOLTEN METALS.
A.M.Samarin and D.Ya.Svet.
Dokl. Akad. Nauk SSSR, Vol. 126, No. 1, 78-80 (May 1, 1959).
In Russian.

A previously described method of modulation reflectometry (Abstr. 7316 of 1956) is applied to Fe, Co, Ag, Cu and Ni close to the solidification temperature for λ 0.4-2.1 μ; also to NiCu alloys at 0.62 μ. The emissivity over the visible spectrum is similar to that for a solid at room temperature, but higher than that for a solid in the infrared. This is ascribed, in general, to the change of resistivity with temperature. R.Berman

536.3 : 535.39

EMISSIVITY OF GRAPHITE AT ARC TEMPERATURE. See Abstr. 13186

536.3 : 535.39 : 525.3

13216. TEMPERATURE STABILIZATION OF HIGHLY REFLECTING SPHERICAL SATELLITES.
G.Hass, L.F.Drummeter, Jr and M.Schach.
J. Opt. Soc. Amer., Vol. 49, No. 9, 918-24 (Sept., 1959).

The temperature of an orbiting satellite with small internal power dissipation is determined by its radiation environment, the radiation properties of its surface, and orbital geometry. These parameters are considered for a spherical satellite. The available design parameter is the ratio of the effective solar absorptance of the exterior surface to the hemispheric emittance. The construction of a surface which has high specular reflectance and controllable low-temperature emittance is achieved by applying an evaporated layer of silicon monoxide over a highly reflecting aluminium surface. Information on the generation of uniform films on a spherical surface is presented along with data on the infrared properties and emittances of filmed surfaces. The successful application of this method of controlling temperature is demonstrated by the temperature behaviour of Vanguard II (1959 α) in orbit.

536.3 : 551.510.5

INFERENCE OF ATMOSPHERIC STRUCTURE FROM REMOTE RADIATION MEASUREMENTS. See Abstr. 12896.

536.413

13217. CALCULATION OF THE THERMAL EXPANSION OF SOLIDS FROM THE THIRD-ORDER ELASTIC CONSTANTS.
F.W.Sheard.
Phil. Mag. (Eighth Ser.), Vol. 3, 1381-90 (Dec., 1958).

The thermal expansion of a solid is due to anharmonicity of the interatomic forces. It may therefore be calculated, on the basis of a continuum model, from the observed elastic anharmonicity, i.e. the third-order elastic constants. Using Lazarus' (1949) measurements on the pressure variation of the elastic moduli of several cubic crystals, the Grüneisen γ is calculated for the limiting cases of low and high temperatures. For KCl, NaCl the high temperature values agree with those obtained from the thermal expansivities, and a decrease in γ at low temperature is predicted. However, Lazarus' data on metals cannot be reconciled with the thermal expansions, which suggests that the continuum model is inapplicable to these cases.

536.413.2 : 537.226.2

13218. THERMAL EXPANSION OF TRIGLYCINE SULPHATE CRYSTALS IN THE REGION OF THE FERROELECTRIC TRANSITION. Z.I.Ezhkova, G.S.Zhdanov and M.M.Umanskii.
Kristallografiya, Vol. 4, No. 2, 249-53 (March-April, 1959).
In Russian.

An X-ray method is used to measure the interplanar distances d_{100}, d_{001}, d_{010}, and d_{101} in triglycine sulphate from 25° to 75°C. Graphs of the interplanar distances, the corresponding thermal expansion coefficients, the area S in the (010) plane and the volume plotted against temperature are reproduced. All the graphs show discontinuities at the Curie temperature (47°C) of the transition from the space group $P2_1$ to $P2_1/m$. The three principal expansion coefficients, and the angle between the thermal expansion α_{11} and the a axis are tabulated at 25°, 42.5° and between 51° and 75°C. R.F.S.Hearmon

536.413.2 : 548.736.6

LINEAR EXPANSION OF PHLOGOPITE AND MUSCOVITE.
See Abstr. 12881

536.413.3 : 538.2

13219. MANGANESE–ARSENIC–ANTIMONY ALLOYS WITH INVAR CHARACTERISTICS. W.Köster and E.Braun.
Ann. Phys. (Leipzig), Folge 7, Vol. 4, No. 1-5, 66-8 (1959).
In German.

The ferromagnetic alloys MnAs and MnSb form solid solutions over the whole composition range. Spontaneous magnetostriction which is superposed upon ordinary thermal expansion below the Curie temperature results in an overall contraction in MnSb, but in an expansion in MnAs. A gradual transition from contraction to expansion takes place in the mixed alloys with increasing MnAs content. Certain composition ranges have extremely small expansion coefficients which are comparable to those of invar. R.Parker

536.413.3 : 538.27

13220. NUCLEAR MAGNETIC RESONANCE AND THERMAL EXPANSION IN PARTIALLY CRYSTALLINE POLYPROPYLENE, POLY(BUTENE-1), AND POLY(PENTENE-1).

J.Sauer, A.E.Woodward and N.Fuschillo.
J.appl. Phys., Vol. 30, No. 10, 1488-91 (Oct., 1959).

The specific volume of partially crystalline specimens of polypylene, poly(butene-1) and poly(pentene-1) from about 160°K to ove the melting point has been studied. In addition, proton spin gnetic resonance of a partially crystalline poly(butene-1) specimen s been observed over the 77°K to 320°K temperature range. Per-nt crystallinities as functions of temperature for polypropylene d poly(butene-1) calculated from the specific volume data are mpared. The poly(butene-1) specimens show higher densities n the polypropylene samples at 170-180°K although the crystallinies of the former are 25-40% lower than the latter. In addition, the mperature dependence of the specific volume from 160-280°K is eater for poly(butene-1) than for polypropylene. Somewhat similar nds are noted in a comparison of the nuclear magnetic resonance cond moment versus temperature curves for these two materials.

536.413.3

13221. TEMPERATURE HYSTERESIS OF THE VOLUME IN MORPHOUS SUBSTANCES. Yu.A.Gorbatkina.
.. tekh. Fiz., Vol. 29, No. 3, 346-9 (1959). In Russian.

It was found that polystyrene, polymethylmethacrylate and lyvinyl chloride exhibit thermal expansion hysteresis: the lume—temperature cooling curves are not identical with the ating curves, even at the same rates of heating and cooling. is happens in the region of transition (softening) temperatures.

536.421.1 : 551.16

13222. FUSION CURVE OF IRON TO 96 000 ATMOSPHERES: EMPERATURE OF THE EARTH'S CORE. H.M.Strong.
ature (London), Vol. 183, 1381-2 (May 16, 1959).

Using the same apparatus as that used for the synthesis of diamond [Bundy, Hall, Strong and Wentorf, Nature (London), Vol. 176, (1955)], the author found that, at 96 000 atm, the melting point of on was 1740 ± 15°C, the fusion curve following a smooth course ver the entire pressure range. Simon's fusion equation $/a = (T/T_0)^c - 1$, which (with a = 75 000 atm, and c = 8) fitted the xperimental results, was used to extrapolate the fusion curve and elded, at 1.4×10^6 atm, the melting point of 2340 ± 50°C. Taking to account the effect of dissolved foreign atoms on the melting oint and a drift of the extrapolation away from the true curve, the elting point at the boundary of the earth's core is likely to lie in e range 2340 ± 200°C. F.Lachman

536.421.1 : 539.89

13223. PHASE DIAGRAM OF RUBIDIUM TO 150 000 kg/cm² AND 00°C. F.P.Bundy.
hys. Rev., Vol. 115, No. 2, 274-7 (July 15, 1959).

A room-temperature transition was found in rubidium at 07 000 kg/cm². It is characterized by an abrupt increase in electrical resistance of about 12 to 15%. The melting temperature increased with pressure in a normal manner up to about 25 000 kg/cm²; hen the rate of rise diminished rapidly until a maximum melting oint of about 280°C was reached at 50 000 kg/cm². Beyond this the elting point decreased with increasing pressure. A triple point at 12 000 kg/cm², 200°C occurred at the junction of the solid I-II line nd the melting line. Only electrical resistance type measurements ere made. Other transitions might be shown by volume measurements.

536.421.1 : 539.89

13224. FUSION CURVES FOR FOUR GROUP VIII METALS TO 00 000 ATMOSPHERES. H.M.Strong and F.P.Bundy.
hys. Rev., Vol. 115, No. 2, 278-84 (July 15, 1959).

The fusion curves of Ni, Pt, Rh, and Fe were experimentally etermined to 100 000 atm. At this pressure, the melting points of he pure metals were: Ni, 1670 ± 10°C; Pt, 2070 ± 15°; Rh, 2400 ± 15°; e, 1740 ± 10°. The Pt and Rh values were extrapolated by Simon's usion equation which fitted all of the data quite well and enabled the olume changes at the m.p. to be computed. $\Delta V/V_S$ for the four etals were : Ni, 0,06 ± 0.01; Rh, 0.12 ± 0.03; Fe, 0.03 ± 0.005. he constants of Simon's equation differed considerably from their heoretical values but a functional relationship appears evident between Simon's exponent c and the Grüneisen constant γ.

536.423.4

13225. SOME PROBLEMS OF THE LIQUEFACTION OF HYDROGEN ND THE STORAGE OF LIQUID HYDROGEN AND HELIUM.
M.P.Malkov.
Bull. Inst. Internat. Froid, Annexe 1958-1, 61-70.

A brief discussion of ortho—para conversion, the use of powder insulation in liquefiers, gas purification and liquid storage.
R.G.Chambers

536.424 : 538.27

13226 ON A PHASE CHANGE IN PARADICHLOROBENZENE AT VERY LOW TEMPERATURES. J.Rosset and M.Buyle-Bodin.
Arch. Sci. (Geneva), Vol. 12, Special No., 179-81 (1959). In French.

1959 Maxwell-Ampere Conference paper (see Abstr. 11542 of 1959). Reports a new phase, in addition to the three already known, in solid paradichlorobenzene detected via the Cl^{35} pure quadrupole magnetic resonance signal. It is produced by keeping a single crystal at 70°K for up to 36 hours. J.G.Powles

536.424.1 : 539.89

13227. P—T DIAGRAMS OF THALLIUM. E.G.Ponyatovskii.
Kristallografiya, Vol. 4, No. 2, 257-9 (March-April, 1959). In Russian.

The pressure—temperature diagram of thallium is determined up to 500°C and 33 000 Kg/cm² by a thermal analysis method, and the results compared with those of Bridgman (1935). The temperatures of melting, of solidification and of the $\alpha \rightarrow \beta$, $\beta \rightarrow \alpha$ transitions are given. It is found that the temperatures of the $\beta \rightarrow \alpha$ and $\alpha \rightarrow \beta$ transitions are subject to hysteresis and depend on the rate of heating or cooling of the specimen. R.F.S.Hearmon

536.48 : 537.311.31

13228. LOW-TEMPERATURE TRANSPORT PROPERTIES OF COPPER AND ITS DILUTE ALLOYS: PURE COPPER, ANNEALED AND COLD-DRAWN. R.L.Powell, H.M.Roder and W.J.Hall.
Phys. Rev., Vol. 115, No. 2, 314-23 (July 15, 1959).

Experimental results between 4° and 300°K are given for (1) the thermal conductivity, electrical resistivity, and thermoelectric force and power of two high-purity coppers, one annealed and one cold-drawn 26%; and (2) the electrical resistivity of a series of seven samples of high-purity copper cold-drawn between 0% and 20% elongation. The total electronic thermal resistivities each consist of three terms: the intrinsic resistivity, W_i; the imperfection resistivity, W_0; and a deviation term, W_{i_0}, indicating the departure from strict additivity of W_i and W_0. The intrinsic thermal resistivity and intrinsic electrical resistivity vary as $T^{2.8}$ and $T^{4.5}$, respectively, contrary to the predictions of the usual transport theory using Bloch approximations and assumptions. The resistivity of pure copper is 1.545 μohm cm at 0°C. The increase in imperfection electrical resistivity is approximately linear with increase in cold-drawn elongation. However, the added resistivity is not independent of temperature (Matthiessen's rule), but about twice as great as the ice point as it is at 4°K. The change in the thermoelectric power with drawing is positive at the lower temperatures, but negative above 38°K. The Lorenz number does not approach the Sommerfield value at the lowest temperatures, but flattens out to a value considerably smaller. A qualitative discussion for each of the various effects is given.

536.48 : 539.19

ARGON DEPOSITION ON A 4.2°K SURFACE. See Abstr. 13765

536.48

13229. MEASUREMENTS OF THE MELTING CURVE OF PURE He^3 BELOW THE MINIMUM. J.L.Baum, D.F.Brewer, J.G.Daunt and D.O.Edwards.
Phys. Rev. Letters, Vol. 3, No. 3, 127-8 (Aug. 1, 1959).

The melting pressure was measured by strain gauges attached to a constant-volume vessel filled with the appropriate amount of He^3 so as to give a two-phase equilibrium in the whole region of observation, which ranged from 0.12°K to 0.7°K. The filling capillary was sealed by a solid block of He^3 which formed on cooling with a paramagnetic salt. The minimum of the melting pressure, 29.3 atm, occurs at 0.32°K, confirming the conclusions of Fairbank and Walters [Bulletin of the American Physical Society, 183 (1957)]. The melting pressure rises to 30.8 atm at 0.12°K in agreement with a revised theoretical paper by Bernardes and Primakoff [(Abstr. 11544 of 1959) and erratum, Phys. Rev. Letters, Vol. 3, No. 3, 144 (1959)]. The measurements above the minimum agree with those by Weinstock, Abraham and Osborne (Abstr. 2677 of 1952). H.London

536.48

13230. GROUND STATE OF LIQUID HELIUM. I.L.Karp.
Phys. Rev., Vol. 115, No. 2, 223-6 (July 15, 1959).

A calculation scheme suitable for studying the ground state

of many-body Bose quantum systems with strong forces is developed. The calculation scheme is based on the nodeless property of the ground-state wave-function and is capable of yielding in some cases upper and lower bounds on the ground-state energy and corresponding wave-functions. From a treatment of liquid helium in the ground state, including a short-range interaction form, it is concluded that the calculation scheme is suitable for problems with involved interactions and is capable of reducing the problem to the mathematical one of calculation of the energy and lattice structure of a classical crystal at absolute zero of temperature.

536.48

13231. THE TRANSITION TEMPERATURE IN LIQUID HELIUM. II. S.G.Brush.
Proc. Roy. Soc. A, Vol. 247, 225-36 (Sept. 16, 1958).

The Feynman—Kikuchi theory of the λ-transition, discussed in Pt I (Abstr. 155 of 1958), is improved in various respects. A more general formulation of the approximate path integral for two-atom permutations gives the result that these permutations should be unimportant except below about 1°K, where they may become more important than the other kinds of permutations. The lattice model is generalized by allowing vacant lattice sites (holes) so that there is a gas-liquid transition as well as a λ-transition. If one assumes that the lattice spacing is fixed and the only effect of pressure is to change the number of holes, then one finds that the transition temperature decreases with pressure if the "effective mass" for many-sided polygons is taken to be more than twice the real mass. On the other hand, with such a large effective mass the transition temperature itself comes out too low. If one allowed the lattice spacing and effective mass to vary with pressure, one could obtain better numerical agreement with experiment, but with so many adjustable parameters such agreement would not be significant. The effect of lattice structure on the transition is also discussed, and it is found that the product of effective mass, square of lattice spacing, and transition temperature should increase with the coordination number of the lattice. The treatment can also be extended to mixtures of helium isotopes; the effect of small amounts of He^3 or He^6 is similar to that predicted by other theories.

536.48

13232. VISCOSITY AND HEAT CONDUCTIVITY OF LIQUID He^3. S.K.Trikha.
Progr. theor. Phys., Vol. 17, No. 4, 609-11 (April, 1957).

An attempt is made to express the temperature effect on the viscosity of He^3 by Andrade's formula. This is shown to agree better with the few available measurements than the deduction for an ideal Fermi gas. Using an approximate expression for the saturation pressure, the entropy of vaporization is expressed in terms of viscosity data. It is found that this entropy is smaller than that entropy which is derived by way of Trouton's rule. The deviation from the latter is assumed to originate in the zero-point energy. The corresponding value of this energy is 63 cal/mole. The author claims this value to be in accordance with independent estimates of the zero-point energy. R.Eisenschitz

536.48

13233. THEORY OF THE FERMI FLUID (THE PROPERTIES OF LIQUID He^3 AT LOW TEMPERATURES).
A.A.Abrikosov and I.M.Khalatnikov.
Uspekhi fiz. Nauk, Vol. 66, No. 2, 177-212 (Oct., 1958). In Russian.
English translation in: Soviet Physics—Uspekhi (New York), Vol. 66(1), No. 1, 68-90 (Sept.-Oct., 1958).

A review of Landau's theory of Fermi liquids (Abstr. 8604 of 1956) as applied to He^3 at very low temperatures. The theory is applied here to the heat capacity, magnetic susceptibility, viscosity, thermal conductivity, sound propagation, "zeroth sound" (a wave motion involving oscillatory deformations of the Fermi surface and arising only when collisions are negligible), dispersion and absorption of both types of sound, spin waves, and the scattering of light by zeroth sound (i.e. by fluctuations of the distribution function). The experimental data on these effects are also mentioned, but they do not yet extend to low enough temperatures ($< 0.2°$K) to test the theory. Two appendices treat the microscopic basis of the theory: the first describes the authors' treatment (Abstr. 5666 of 1958) of a hard-sphere Fermi gas; the second, Landau's general treatment (Abstr. 2084 of 1959), applying to any interaction. 21 references. O.Penrose

536.5

13234. THE FREEZING POINT OF ZINC AS A PRIMARY POINT OF THE INTERNATIONAL TEMPERATURE SCALE.
C.R.Barber and A.Horsford.
Proc. Roy. Soc. A, Vol. 247, 214-24 (Sept. 16, 1958).

The technique is described of achieving the highest accuracy o measurement with platinum resistance thermometers at the freezi point of zinc and the boiling point of sulphur. The two points are compared in a series of measurements and it is found that the zinc point is some three or four times more reproducible than the sulp point. It is concluded that the substitution of the zinc point for the sulphur point as a primary fixed point of the International Temperature Scale would lead to a greater precision in the definition of the scale. The value of the freezing point of zinc is found to be 419.5055 ± 0.002°C.

536.587 : 53

USE OF THE CURIE POINT OF FERRITES FOR TEMPERATURE REGULATION. See Abstr. 13444

536.62

13235. A CRYOSTAT FOR MEASURING SPECIFIC HEATS BETWEEN 1 AND 4.2°K USING A MECHANICAL THERMAL SWITCH. F.D.Manchester.
Canad. J. Phys., Vol. 37, No. 9, 989-1001 (Sept., 1959).

A design for a low temperature cryostat using a mechanical thermal switch is described and its performance and some general features of interest in its operation, such as the importance of vibration, are discussed. Sample measurements on pure copper and a cupronickel alloy are presented.

536.63

13236. CALCULATION OF THE SPECIFIC HEAT OF SOME ALKALI HALIDES. C.Oliphint.
Phys. Rev., Vol. 115, No. 2, 296-7 (July 15, 1959).

The specific heats of LiF, KCl, and KI were calculated using Houston's approximation to find the frequency spectrum. These calculations are compared to measurements of specific heat, to a calculation using Debye's theory, and to a calculation by Briscoe and Squire. The specific heat curves are plotted by Bijl's method.

536.631 : 537.312.

13237. SPECIFIC HEAT MEASUREMENTS AND THE ENERGY GAP IN SUPERCONDUCTORS. L.N.Cooper.
Phys. Rev. Letters, Vol. 3, No. 1, 17 (July 1, 1959).

If the B.C.S. theory is generalized by supposing the electron—electron interaction to be anisotropic, then the energy gap also becomes anisotropic. This may account for deviations between experimentally observed specific heat curves and the curve predict by the simple B.C.S. theory. R.G.Chamber

536.6

13238. THE HEATS OF MIXING IN THE SYSTEM ANTIMONY—BISMUTH AT 700°C. F.E.Wittig and E.Gehring.
Naturwissenschaften, Vol. 46, No. 6, 200 (1959). In German.

With the aid of a high-temperature calorimeter, developed for the purpose, a linear relationship was established between the ξ-function and the atomic composition. The previous work of Kawakami (Abstr. 1714 of 1931) had not permitted any relationship to be deduced. J.Thewli

THERMODYNAMICS

536.7

13239. NEGATIVE TEMPERATURES. P.T.Landsberg.
Phys. Rev. Vol. 115, No. 3, 518-20 (Aug. 1, 1959).

It is shown by an example how the concept of negative tempera ture finds a natural place in the approach to thermodynamics which was originated by Carathéodory.

536.7

13240. CONDITIONS FOR EQUILIBRIUM AT NEGATIVE ABSOLUTE TEMPERATURES. B.D.Coleman and W.Noll.
Phys. Rev., Vol. 115, No. 2, 262-5 (July 15, 1959).

In the classical phenomenological thermodynamic theory of Gibbs, equilibrium is defined as the state of maximum entropy at constant energy, and a theorem is proved (the energy theorem) which asserts that the equilibrium state is the state of minimum energy at fixed entropy. This theorem is not true for systems at negative absolute temperatures. By examining a familiar statistic

odel which can exhibit negative absolute temperatures one finds the rrect form of the energy theorem. It turns out that at negative solute temperatures the state of equilibrium of a system with a ven entropy is that in which the system has its highest energy.

536.791

241. THIRD LAW OF THERMODYNAMICS. G.Falk.
ys. Rev., Vol. 115, No. 2, 249-53 (July 15, 1959).
A new formulation of the third law is proposed stating a iversal connection between the lower limits of the energy and the tropy of any physical system. As consequences of the new eorem are derived the Nernst heat theorem, a theorem concerning e lowest energy state of mixtures, and the nondegeneracy of the ergetic ground state of physical systems.

ELECTRICITY

ELECTROSTATICS . DIELECTRICS

537.221

3242. THE INFLUENCE OF SURFACE STATES OF PbS AND dS ON THE CONTACT POTENTIAL. L.P.Strakhov.
iz. tverdogo Tela, Vol. 1, No. 4, 583-8 (April, 1959). In Russian.
The author measured the contact potentials with respect to Pt d Au of various specimens of PbS and CdS as a function of mperature, illumination, and applied magnetic field. Kelvin's ibrating condenser method was used. The results showed a con- derable variation of contact potential with orientation of the PbS lms and with intensity of illumination. A field of 9000 G, applied the plane of the specimens, produced a small change in contact otential. M.G.Priestley

537.226.1 : 535.393

3243. A NOTE ON THE THEORIES UNDERLYING THE OLARIMETRIC STUDY OF VERY THIN DIELECTRIC SURFACE AYERS. S.Nomura and K.Kinosita.
. Phys. Soc. Japan, Vol. 14, No. 3, 297-303 (March, 1959).
The polarimetric study of very thin dielectric surface layers on ielectric substrates has been most frequently based on Drude's heory, or on Sissingh and Groosmuller's theory (obtained by im- roving the approximation of Drude's calculation). These theories re derived by modifying the boundary conditions for Maxwell's quations. A quite different approach to this problem is possible, owever, based on the interference of light inside the surface layer. t has been proved by several workers that Drude's theory is onsistent with the interference theory. It is proved in this paper hat Sissingh and Groosmuller's theory is also consistent with the nterference theory. Some useful formulae emerging from the roof are given.

537.226.2

3244. THE ROTATION OF WATER MOLECULES AND THE DIELECTRIC PROPERTIES OF ZEOLITES. P.Ducros.
rch. Sci. (Geneva), Vol. 12, Special No., 73-7 (1959). In French.
1959 Maxwell-Ampere Conference paper (see Abstr. 11542 of 959). A precise analytical study of the dielectric dispersion of habazite shows the insufficiency of Cole's expression (Abstr. 1344 f 1941) for representing the phenomenon. A more general expression s proposed and is, like Cole's, totally empirical.

537.226.2 : 532.133

13245. VARIATION OF RELAXATION TIME WITH VISCOSITY — BENZYL ALCOHOL AND NITROBENZENE. R.Rajan.
Curr. Sci., Vol. 28, No. 6, 238 (June, 1959).
The viscosity of solutions of benzyl alcohol and of nitrobenzene in carbon disulphide was varied by additions of medicinal liquid paraffin. It was found that for benzyl alcohol the dielectric relaxa- tion time exhibits a maximum with increasing viscosity. With both solutes the calculated dipole moment decreases as the viscosity of the solvent is increased. R.Schnurmann

537.226.2

13246. INVESTIGATION OF THE DIELECTRIC POLARIZATION OF METHYLMETHACRYLATE COPOLYMERS WITH STYROL. G.P.Mikhailov and L.L.Burshtein.
Fiz. tverdogo Tela, Vol. 1, No. 4, 632-6 (April, 1959). In Russian.
Concentrations of methylmethacrylate of from 7% to 80% in styrol were used and the effective dipole moment of the polar link in the substitution copolymer determined by the method of Mikhailov and Krasner [Zh. eksper teor. Fiz., Vol. 23, 1131 (1953)]. This was found to coincide with the effective dipole moment of the monomer at infinite dilution in the non-polar solute. Molecular interaction did not affect the results obtained. The procedure developed permits determination of the dipole moment of a polar link of a macromolecule without use of data for the corresponding low molecular compound. C.R.S.Manders

537.226.2

13247. STRUCTURAL LOSSES IN AMORPHOUS DIELECTRICS. V.Kh.Kozlovskii.
Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 22, No. 3, 279-82 (1958).
In Russian. English summary: PB 141041T-3, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.
Dielectric losses in amorphous materials such as glass are discussed with particular reference to structural losses. Losses in glass should be of the resonance type and of the same nature as in crystals. In crystals, however, resonance absorption occurs only in the infrared region and is independent of temperature, whereas in glass it occurs over a large range of frequencies and varies with temperature. Possible reasons for these differences are examined. R.C.Glass

537.226.2

13248. DIELECTRIC LOSSES IN SIMPLE AND MIXED ALKALI-HALIDE CRYSTALS AT A HIGH FREQUENCY. K.A.Vodop'yanov and G.I.Galibina.
Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 22, No. 3, 288-95 (1958).
In Russian. English summary: PB 141041T-3, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.
The dielectric losses and dielectric constants of simple crystals and of solid solutions were measured at frequencies of 10^5–10^8 c/s and temperatures of 20-320° C. In the series of simple crystals, the loss increases with the distance between the ions, i.e. with decreasing melting point. Small quantities of admixture can cause a considerable increase in conductivity, and therefore of loss angle at low frequencies or high temperatures, the effects being correlated with the structures of the crystals. R.C.Kell

537.226.2

13249. DIELECTRIC LOSSES AND POLARIZATION OF THE POLYMERS. G.P.Mikhailov and A.M.Lobanov.
Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 22, No. 3, 323 (1958).
In Russian. English summary: PB 141041T-3, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.
The effects of the state of the polymer (vitreous, highly elastic or viscous; crystalline or amorphous) on its dielectric properties are briefly described. R.C.Kell

537.226.2

13250. DIELECTRIC LOSSES OF CRYSTALLINE NON-POLAR POLYMERS. S.P.Kabin and G.N.Mikhailov.
Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 22, No. 3, 325-8 (1958).
In Russian. English summary: PB 141041T-3, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.
An outline is given of the effects of crystallization of poly-ethylene and polytetrafluorethylene on their dielectric relaxation. The relaxation periods and activation energies are the same for both the mechanical and dielectric losses. R.C.Kell

537.226.2

13251. DIELECTRIC CONSTANT AND PAIR INTERACTIONS IN GASEOUS HELIUM AND ARGON. G.J.Oudemans and R.H.Cole.
J. chem. Phys., Vol. 31, No. 3, 843-4 (Sept., 1959).
The dielectric constants of A and He were measured at pressures in the range 1 to 100 atm. The Clausius–Mossotti function, $(\epsilon - 1)/(\epsilon + 2)(n/v)$, for He decreases by about 0.3% from 1 to 100 atm; but remains constant for A to within 0.2% to 130 atm. These results are at variance with theoretical analyses of pair interactions, and the only calculations suggesting a negative contribution in this range of densities are those of ten Seldam and de Groot (Abstr. 2256 of 1953). R.F.Barrow

537.226.2

13252. RELAXATION POLARIZATION DIELECTRICS. AN ASSESSMENT OF THE SYSTEM (Sr, Ba, Ca) TiO_3–Bi_2O_3–TiO_2.
R.M.Glaister and J.W.Woolner.
J.Electronics and Control, Vol. 6, No.5, 385-96 (May, 1959).

Ceramic solid solutions of the system $SrTiO_3$–$Bi_2O_3.nTiO_2$, where n was varied between 0 and 4, have been prepared from $SrCO_3$ or $SrTiO_3$, Bi_2O_3 and TiO_2 in a wide range of compositions for assessment as capacitor dielectrics. The effect of partial and complete substitution of Ba or Ca for Sr has also been investigated. Dielectrics were prepared with permittivities of up to 1500 at room temperature and a negative temperature coefficient above -80°C. Some compositions examined had dielectric loss tangents below 0.003 over the range -30°C to 200°C at frequencies below 1 Mc/s, and promise to be useful as capacitor dielectrics. Above 1 Mc/s the dielectric loss rises rapidly. The ceramics with n = 2 showed loss maxima at -125°C and peak permittivities at about -90°C.

537.226.2

13253. LANOSTEROL, AN ORGANIC, NONLINEAR DIELECTRIC.
G.Helwig.
Z. angew. Phys., Vol. 11, No. 7, 255-9 (July, 1959). In German.

Measurements of permittivity are reported, both on solidified lanosterol, and on lanosterol-impregnated paper capacitors. The permittivity decreases when a d.c. bias field is applied, following roughly a square law. Apart from an almost instantaneous effect, there is a larger, time dependent, effect, which at room temperature takes about 300 hours to saturate. The decrease in capacitance is then about 10% at a field of 114 kV/cm. Both short and long term effects are reversible. It is suggested that OH dipoles in the lanosterol molecules are moved into positions by the d.c. field in which they contribute less effectively to the polarization due to the a.c. measuring field. K.W.Plessner

537.226.2

13254. THE ACTION OF AN ELECTRIC FIELD ON THE DIELECTRIC PROPERTIES OF TRIGLYCINE SULPHATE.
J.Chapelle and L.Taurel.
C.R. Acad. Sci. (Paris), Vol. 249, No. 3, 378-80 (July 20, 1959). In French.

Devonshire's treatment is applied to triglycine sulphate, and values derived for the constants in the free energy expression from dielectric measurements near the Curie temperature. It would appear that v.l.f. electric measurements were made, as only isothermal processes are considered. A more complete derivation, including the adiabatic correction,has been given by Triebwasser (Abstr. 5656 of 1959). L.E.Cross

537.226.2

13255. POLARIZATION REVERSAL IN TRIGLYCINE SULPHATE CRYSTAL. K.Zen'iti, K.Husimi and K.Kataoka.
J. Phys. Soc. Japan, Vol. 13, No. 6, 661 (June, 1958).

Measurements by an ultrasonic method give the spontaneous polarization as 3.3 $\mu C/cm^2$ (cf. 2.2 $\mu C/cm^2$ previously reported). The effects of repeated pulses of various widths and field strengths on the polarization are given. Slower switching and lower saturation polarization are obtained in poor quality crystals or when unsuitable electrodes are used or in a damp atmosphere. R.C.Kell

537.226.2

13256. SOME FERROELECTRICAL PROPERTIES OF TRIGLYCINE SULFATE. H.Toyoda, S.Waku, H.Shibata and Y.Tanaka.
J. Phys. Soc. Japan, Vol. 14, No. 1, 109-10 (Jan., 1959).

Results of measurements at room temperature, 0° and -73°C are given for the spontaneous polarization and for the dependence of the coercive field on the applied field, of the average polarization on the number of repeated pulses of various shapes, of the piezoelectric output on the average polarization, and of the maximum switching current on the applied field. R.C.Kell

537.226.2 : 548.5

13257. PRODUCTION OF TRIGLYCINE SULPHATE CRYSTALS AND THEIR PHYSICAL PROPERTIES.
V.P.Konstantinova, I.M.Sil'vestrova and K.S.Aleksandrov.
Kristallografiya, Vol. 4, No. 1, 69-73 (1959). In Russian.

A method of producing triglycine sulphate, a ferroelectric substance, is described. The crystals are monoclinic, belonging to class 2; data are given for the dependence of solubility on temperature and of the dielectric constant ϵ_{22} on frequency and field strength. Room temperature values are tabulated for the 4 dielectric constants, the 8 piezoelectric constants and the 13 elastic stiffnesses and compliances, determined by an ultrasonic pulse method. See also the two following abstracts. R.F.S.Hearmon

537.226.2 : 548.5

13258. TWINNING AND DIELECTRIC PROPERTIES OF TRIGLYCINE SULPHATE CRYSTALS.
V.P.Konstantinova, I.M.Sil'vestrova and V.A.Yurin.
Kristallografiya, Vol. 4, No. 1, 125-9 (1959). In Russian.

Photographs of twinned specimens and of etch figures are reproduced. Hysteresis loops at six temperatures are illustrated; curves are given for the dependence of spontaneous polarization on temperature and of dielectric constants on temperature, frequency and field strength. R.F.S.Hearmon

537.226.2

13259. THE QUESTION OF THE DOMAIN STRUCTURE OF TRIGLYCINE SULPHATE CRYSTALS.
L.A.Shuvalov, K.S.Aleksandrov and I.S.Zheludev.
Kristallografiya, Vol. 4, No. 1, 130-2 (1959). In Russian.

The reversible phase transition between the point groups 2 : m and 2 in triglycine sulphate is considered in relation to domain structure. Two models are suggested, one consisting of an antiparallel arrangement of right-handed and left-handed domains, and the second consisting of an antiparallel arrangement of right (or left) handed domains only. The piezoelectric, elastic and polarization properties of both models are examined, and it is concluded that when the material crystallizes above the Curie temperature the domain structure corresponds with the first model, but crystals produced below the Curie temperature may correspond to a mixture of the two models. R.F.S.Hearmon

537.226.2 : 536.413.2

THERMAL EXPANSION OF TRIGLYCINE SULPHATE CRYSTALS IN THE REGION OF THE FERROELECTRIC TRANSITION. See Abstr. 13218

537.226.2 : 548.737

CRYSTAL STRUCTURE OF THE FERROELECTRIC PHASE OF $(GLYCINE)_3.H_2SO_4$. See Abstr. 13958

537.226.

13260. INFLUENCE OF CONDITIONING TEMPERATURE ON THE ELECTRICAL PROPERTIES OF ROCHELLE SALT CONTAINING IMPURITIES. V.A.Yurin and I.S.Zheludev.
Kristallografiya, Vol. 4, No. 2, 253-5 (March-April, 1959). In Russian.

The effect of annealing on the hysteresis loops and permittivity of Rochelle salt containing Cu was studied. It was found that the double hysteresis loops (Abstr. 3071 of 1958) disappeared on annealing, but reappeared on standing, and that the Curie point was lowered by annealing. R.F.S.Hearmon

537.226.

13261. DIELECTRIC PROPERTIES OF SOME METANIOBATE AND METATANTALATE CERAMICS. R.V.Coates and H.F.Kay.
Phil. Mag. (Eighth Ser.), Vol. 3, 1449-59 (Dec., 1958).

The preparation and basic dielectric properties of the metaniobates and metatantalates of iron, maganese, lead, tin, calci strontium and barium (all in the divalent state), and trivalent aluminium are described. Manganese metatantalate, barium, metaniobate, and aluminium metaniobate have been found to be ferroelectric, and lead metatantalate antiferroelectric. These are in addition to ferroelectric lead metaniobate discovered by Goodma in 1953. Strontium and barium metatantalates may have transition points below -183°C.

537.226.2 : 538

13262. ANALOGY BETWEEN A FERROELECTRIC PHENOMENO AND A FERROMAGNETIC ONE: ATTENUATION OF FERROELECTRIC HYSTERESIS BY ORTHOGONAL POLARIZATION.
Y.Angel and J.Bonnefous.
C.R. Acad. Sci. (Paris), Vol. 249, No. 4, 508-10 (July 27, 1959). In French.

Ceramics of barium and strontium titanates (TiO_3Ba_x, Sr_{1-x}) i the form of plates 1 mm thick have been subject to a longitudinal static electrical field applied parallel to the largest dimension and a 50 c/s transverse field applied between the largest faces. The longitudinal field was increased in steps up to 16 kV/cm while the transverse field was varied between zero and a maximum of either 3630 or 8460 V/cm. The existence of the static field modified the relationship between the displacement and the transverse field. Hysteresis loops were traced by an oscilloscope method and it was

d that the area of the loop decreased as the strength of the itudinal field was increased. Thus it is assumed that further ease of this field should lead to the elimination of hysteresis and establishing of a linear relation between the displacement and the sverse field, such as has been observed in ferromagnetism.
A.E.Kay

537.226.2

63. THE INFLUENCE OF GRINDING ON THE DIELECTRIC PERTIES OF POLYCRYSTALLINE BARIUM TITANATE.
.Kovalenko.
Akad. Nauk SSSR, Ser. fiz., Vol. 22, No. 3, 321-2 (1958). In sian. English summary : PB 141041T-3, obtainable from Office echnical Services, U.S. Dept. of Commerce, Washington, D.C., .A.
The polarization of ceramic $BaTiO_3$, as measured from a steresis loop with 6 kV/cm maximum field strength, is shown to reduced as the specimens are ground thinner. The effect comes pronounced at thicknesses below 0.05 cm. Untreated cimens, made and fired to thinner dimensions, show slightly anced polarization with decreasing thickness. The reduced arization is attributed to damaged surface layers produced by grinding process. L.E.Cross

537.226.2

64. MICRO-RELIEF AND DOMAIN STRUCTURE ON THE RFACE OF BARIUM TITANATE SINGLE CRYSTALS.
gras, G.V.Spivak and I.S.Zheludev.
stallografiya, Vol. 4, No. 1, 121-3 (1959). In Russian.
Microscopic and electron-microscopic examination was made surface deformations outlining domain regions. The deformations e found to be of two types, one of which disappears above the ie temperature, whereas the other does not. See also following tract. R.F.S.Hearmon

537.226.2

65. THE OBSERVATION OF DOMAIN STRUCTURE IN BARIUM 'ANATE BY MEANS OF AN ELECTRON MIRROR.
.Spivak, E.Igras, I.A.Pryamkova and I.S.Zheludev.
stallografiya, Vol. 4, No. 1, 123-5 (1959). In Russian.
The construction of an all-metal electron mirror microscope str. 405 of 1956) is described. Photographs of domain structure single crystal $BaTiO_3$ obtained with the equipment are repro- ed. R.F.S.Hearmon

537.226.2 : 539.219

DIELECTRIC CONSTANT OF $BaTiO_3$–$BaZrO_3$ SOLID SOLU- ONS. See Abstr. 12819

537.227

66. DEMONSTRATION EXPERIMENTS ON PYROELECTRICITY TH LIQUID AIR. K.Clusius.
Elektrochem., Vol. 63, No. 1, 12-13 (1959). In German.
Dewar's observation, that uranyl nitrate cleared liquid air by racting ice particles etc. to it because of its electric charge, has n converted into a demonstration experiment using tourmaline.
J.M.Hough

537.228.1

67. STABILITY OF THE PIEZOELECTRIC EFFECT IN ESSED BARIUM TITANATE. M.M.Kitaigorodskii.
. tverdogo Tela, Vol. 1, No. 4, 628-9 (April, 1959). In Russian.
Pressed barium titanate samples were prepared by annealing at 0°C and subsequent pressing, using an organic binder. Dielectric rmittivity of 40-95, Q-factor of 100-350) and piezoelectric (d_{33} dulus of $0.6 \times 10^{-7} - 10^{-6}$ c.g.s. units) properties of these samples re found to be practically the same after six years. They were not ected by heating to 70°C for many hours or by application of V/cm 6 kc/s or 1 kV/cm d.c. fields. On being placed in a 100% ative-humidity atmosphere the piezo-modulus rose by a factor 2, but it regained its original value after thorough drying.
A.Tybulewicz

537.228.1

268. PIEZOELECTRIC PROPERTIES OF TRIGLYCINE LPHATE CRYSTAL. K.Husimi and K.Kataoka.
Phys. Soc. Japan, Vol. 14, No. 1, 105 (Jan., 1959).
Values of three piezoelectric and elastic constants obtained om resonance measurements are given. The d_{23} constant is very ·ge. It rises rapidly near the Curie point, then drops steeply t continuously to zero, showing that the transition is second der. R.C.Kell

537.228.1

13269. EXPERIMENTAL INVESTIGATIONS ON THE DEVELOPMENT OF NEW PIEZOELECTRIC SUBSTANCES.
I.S.Rez, A.S.Sonin, E.E.Tsepelevich and A.A.Filimonov.
Kristallografiya, Vol. 4, No. 1, 65-8 (1959). In Russian.
Qualitative examination enables materials to be divided into three groups: (a) those with appreciable piezoelectric activity, equal to, or greater than, that of a quartz standard excited under the same conditions; (b) those with activity less than that of the quartz; (c) those with no activity. 356 compounds belonging to groups (a) and (b) are listed and classified as follows: inorganic and complex compounds: 39 of group (a), 43 of group (b); organic compounds: 90 of group (a), 184 of group (b). R.F.S.Hearmon

537.228.4

13270. THERMAL VARIATION OF THE KERR EFFECT IN A VISCOUS INSULATOR IN AN ALTERNATING ELECTRIC FIELD.
J.Rabinovitch and J.Michel.
C.R. Acad. Sci. (Paris), Vol. 248, No. 4, 548-50 (Jan. 26, 1959). In French.
Describes experiments in which the electrical birefringence of Pyralene (a mixture of chlorobenzene and diphenylchloride) was measured at temperatures between -5° and +90°C. A maximum at 7°C was observed, in good agreement with the result expected from its dielectric properties. A.E.I. Research Laboratory

ELECTRIC CONDUCTION SEMICONDUCTORS

537.311.1

13271. SOME PROPERTIES OF RELAXATION FUNCTIONS AND KINETIC COEFFICIENTS. M.I.Klinger.
Fiz. tverdogo Tela, Vol. 1, No. 4, 674-8 (April, 1959). In Russian.
Considers the formal expression for the current density and derives general relations between the real and imaginary parts of the conductivity components. M.G.Priestley

537.311.1 : 530.162

A METHOD OF CALCULATING ELECTRICAL CONDUCTIVITY. See Abstr. 13039

537.311.3

13272. OXIDES WHICH SHOW A METAL-TO-INSULATOR TRANSITION AT THE NÉEL TEMPERATURE. F.J.Morin.
Phys. Rev. Letters, Vol. 3, No. 1, 34-6 (July 1, 1959).
The variation with temperature of the electric conductivity was measured on specimens of polycrystalline TiO and on single crystals of Ti_2O_3, VO, V_2O_3 and VO_2. In V_2O_3 and VO the transition from metal to insulator is very abrupt, whereas in VO_2 and in Ti_2O_3 it is spread out over a range of temperatures, and TiO is a metal down to 1.5°K. A slight hysteresis was observed. In VO and TiO the phenomenon is explained by the splitting of the d-band when the oxide becomes antiferromagnetic: in VO the lowest band is full, in TiO it is still partly empty. The processes that may occur in the more complicated oxides are discussed. L.Pincherle

537.311.31 : 548.736.3

13273. ELECTRICAL RESISTIVITY AND SUPERSTRUCTURE OF $CuAu_3$. M.Hirabayashi.
J. Phys. Soc. Japan, Vol. 14, No. 3, 262-73 (March, 1959).
The superlattice formation in the alloy $CuAu_3$ containing 75.0% atomic per cent gold was studied by measurements of electrical resistivity and by means of X-ray diffraction with a single crystal. After the alloy was quenched from 450°C, the isothermal change in resistivity was measured at various temperatures between 100° and 220°C. In most of the isothermal measurements, the resistivity increased monotonously with the time of annealing, possessing an activation energy of 25 ± 2 kcal/mol. It was found, however, that after prolonged annealing at 162° and 175°C, a sluggish decrease in resistivity took place following an initial increase. The transition point of this alloy was determined as 200 ± 5°C. Corresponding to the resistivity measurements, X-ray diffraction patterns were taken at various states of ordering at 100°, 150° and 180°C, as well as at the states quenched from 210° and 450°C. It was confirmed that nucleation and growth of small anti-phase domains in the disordered lattice take place in accordance with the rise in resistivity, and that the development of order within the domains plays an important role in the reduction of resisitvity. Then, even after three months anneal-

ing at 180° and 100° C, the ordered alloy $CuAu_3$ has a two-dimensional, rather than one-dimensional, anti-phase domain superstructure with the linear dimension of nearly 11 times the fundamental face-centred cubic cells. In every stage examined, the main lattice reflections were surrounded by fairly strong diffuse scatterings, which is considered to be caused by the thermal motion of atoms, not by the lattice distortion due to ordering. In comparison with the alloy Cu_3Au, the change in resistivity due to ordering is discussed with reference to the X-ray study.

537.311.31 : 536.48

ELECTRICAL RESISTIVITY OF PURE ANNEALED AND COLD-DRAWN COPPER AT LOW TEMPERATURES.
See. Abstr. 13228

537.311.32 : 539.213

13274. THE INFLUENCE OF CALCIUM OXIDE ON THE ELECTRICAL CONDUCTIVITY OF GLASSES CONTAINING TWO ALKALI OXIDES. O.V.Mazurin, E.V.Golikova and N.V.Shtol'tser.
Fiz. tverdogo Tela, Vol. 1, No. 4, 630-1 (April, 1959). In Russian.

SiO_2 replaced by CaO in Na–K and Li–K glasses containing 23, 27 and 33.3% total alkali oxide. Results for 0, 6 and 12% CaO content and varying ratios between the two alkali oxides, at 150° C. Discussion of influence of ionic radii. R.Berman

537.311.33

13275. THERMOELECTRIC AND THERMOMAGNETIC EFFECTS IN SEMICONDUCTORS. O.Madelung.
Semiconductors and phosphors (see Abstr. 9597 of 1959) pp. 178-83. In German.

General discussion of the origin of isothermal and non-isothermal effects in impunity and intrinsic semiconductors. C.A.Hogarth

537.311.33 : 538.2

MAGNETIC SUSCEPTIBILITY OF SEMICONDUCTORS. See Abstr. 12444

537.311.33

13276. THE CONDUCTION MECHANISM OF OXIDE SEMICONDUCTORS AT HIGH TEMPERATURES. J.Rudolph.
Z. Naturforsch, Vol. 14a, No. 8, 727-37 (Aug., 1959). In German.

In the presence of oxygen, the electrical conductivity is influenced not only by the ionization of defects, but also by the change of defect concentration with temperature and oxygen pressure. Two classes of oxides are distinguished according to conductivity type, and their properties are discussed. P.T.Landsberg

537.311.33

13277. IONIZATION BY COLLISION AT N–P JUNCTIONS. G.V.Gordeev.
Fiz. tverdogo Tela, Vol. 1, No. 6, 851-60 (June, 1959). In Russian.

A formula is derived for current multiplication and breakdown voltage at a step junction, in terms of the ionization rates for electrons and holes. A table shows calculated results for p^+n junction with $N_a \gg N_d$ and $N_d = 10^{16}$ cm^{-3}, and a graph gives calculated and experimental V_B–N_d relation. R.Berman

537.311.33 : 539.21

ELECTRON BOMBARDMENT OF SEMICONDUCTORS: TEMPERATURE DEPENDENCE OF DEFECT PRODUCTION.
See Abstr. 13803

537.311.33

13278. THEORY AND APPLICATION OF A MINORITY CARRIER SWEEP-OUT EFFECT. R.D.Larrabee.
J. appl. Phys., Vol. 30, No. 10, 1535-8 (Oct., 1959).

The minority carriers (and their compensating majority carriers) can be removed from a semiconductor by application of an electric field through ohmic contacts. A simplified analytical description of this phenomenon is derived and is illustrated by simple experiments. It is demonstrated that by utilizing this effect, along with Hall data, one can determine the density and drift mobility of both the majority and minority carriers. Consequently, it is possible to measure many parameters that depend on these quantities e.g. intrinsic density, estimate of surface space charge and carrier mobility in inversion surfaces, etc.

537.311.33

13279. TWO-CARRIER SPACE-CHARGE-LIMITED CURRENT IN A TRAP-FREE INSULATOR. R.H.Parmenter and W.Ruppel.
J. appl. Phys., Vol. 30, No. 10, 1548-58 (Oct., 1959).

The space-charge-limited electrical behaviour of a trap-free insulator containing both mobile electrons and holes is investigate under the approximation of neglecting diffusion current. When bo contacts are ohmic, the dependence of two-carrier space-charge-limited current on voltage and interelectrode spacing remains the same as in the one-carrier case; i.e., the current varies as the square of the voltage and as the inverse cube of the spacing. For given voltage and spacing, however, the two-carrier current is usually orders of magnitude larger than the one-carrier current. This is in striking contrast to the case of space-charge-limited flow of electrons and positive ions in a vacuum. The two-carrier current in an insulator can be reduced to the size of the one-carri current either by making one contact highly blocking or by reduci the mobility of one of the carriers to zero. While the first appros yields in detail the well-known one-carrier case, the second appr differs from the one-carrier case in that no net excess space cha can be injected into the insulator. The intermediate case of a sli blocking contact shows that, while the current may be carried ma by one sign of carrier, the net space charge of the insulator can h the opposite sign. When both contacts are blocking, the current saturates for sufficiently high voltages. The current is smaller t the saturation value by an amount proportional to the cube of the interelectrode spacing and the inverse square of the voltage. Nea such saturation, the space charge is negligible and the electric fie is uniform across the insulator. It is plausible that many of the above results will also be true for an insulator with traps.

537.311

13280. THEORY OF THE TRAPPING MECHANISM IN SEMICONDUCTORS. W.Heywang and M.Zerbst.
Z. Naturforsch., Vol. 14a, No. 7, 641-5 (July, 1959). In German.

The evaluation of the characteristic quantities occurring in th Shockley–Read theory, and its extensions, from experimental data discussed. The characteristic quantities include activation energ trap density and capture cross-sections. The experimental data include the effect of traps on photoconductivity for both steady and transient situations. P.T.Landsbe

537.311

13281. EXPERIMENTAL INVESTIGATION OF TRAPPING CENT IN SILICON. M.Zerbst and W.Heywang.
Z. Naturforsch., Vol. 14a, No. 7, 645-9 (July, 1959). In German.

Measurements of the life-time of minority carriers in very p Si (hole density 10^{15} cm^{-3}) have been carried out over the temperature range from −110° to +80° C. Using the theory developed in th preceding abstract; the density, energy level and effective cross-section of the trapping centres are derived from the life-time and photoconductivity data. It is also shown that the traps act by dela ing the recombination of carriers and not by the re-emission of c riers into the minority band. K.W.Pless

537.311.

13282. CROSS-SECTIONS OF POSSIBLE NON-RADIATIVE RECOMBINATION IN SEMICONDUCTORS. I.M.Popov.
Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 505-6 (Aug., 1958). In Russian. English translation in: Soviet Physics–JETP (New York), Vol. 35(8), No. 2, 348 (Feb., 1959).

Criticizes the treatment of Bess (Abstr. 4329 of 1957) and suggests that incorrect wave-functions have been assumed in describing electrons in the conduction and valence bands. The author gives a different calculation of the collision cross-section and concludes that non-radiative processes cannot explain the sho lifetime observed in germanium with a carrier concentration of $\sim 3 \times 10^{13}$ cm^{-3}. D.J.Oliv

537.311.

13283. STUDY ON THE CORRELATION BETWEEN THE NOISE HOLE GENERATION AND SURFACE RECOMBINATION VELOCI AT Ge FUSED JUNCTION. K.Komatsubara.
J. Phys. Soc. Japan, Vol. 13, No. 11, 1409-10 (Nov., 1958).

The effects of vacuum, O_2, N_2, H_2 and oxide layers on the saturation current I_g, surface recombination velocity S and the sq of the mean short circuit noise current of a 1 V reverse biased collector junction of a p–n–p transistor are measured. The rela ship between S, I_g, and the noise produced by hole generation near the junction and recombination at the surface (G–R noise) indicate that the noise is a function of the current flowing and not of the square of the current. Possible explanations are noted. G.C.Willian

537.311.3 : 536.21 : 53

ELECTRICAL AND THERMAL RESISTIVITY OF DISLOCATIONS. See Abstr. 12770

537.311.33

2[illegible]. DIRECT OBSERVATION OF PHONONS DURING [illegible]ELLING IN NARROW JUNCTION DIODES. N.Holonyak, Jr, [illegible]esk, R.N.Hall, J.J.Tiemann and H.Ehrenreich. [illegible]y Rev. Letters, Vol. 3, No. 4, 167-8 (Aug. 15, 1959).
Discontinuities in slope of the current–voltage characteristics [illegible]r observed in heavily doped Si junction at 4.2°K for small [illegible]rd and reverse voltages. Similar cusps were observed in Ge [illegible]s with Sb as donor impurity. Since the conduction and valence [illegible]edges lie at different points of k-space, the tunnelling process, [illegible]ich the observed current is mainly due in such junctions, [illegible]res the participation of phonons. In fact the cusps occur in [illegible], at equal forward and reverse voltages, and their position [illegible]s with the phonon energies deduced from optical measurements. [illegible]greement with these views, no cusps were found with diodes [illegible] of GaSb (both edges at k = 0). L.Pincherle

537.311.33

25. THE DETERMINATION OF DOPING GRADIENTS FROM [illegible]TO-E.M.F. AND PHOTOCONDUCTIVITY IN SEMICONDUC-[illegible]S. M.Zerbst and G.Winstel. [illegible]aturforsch., Vol. 14a, No. 8, 754-5 (Aug., 1959). In German.
The theory of the methods is outlined and measurements on [illegible]rmanium show the feasibility of their use. C.A.Hogarth

537.311.33

2[illegible]. ELECTRON-OPTICAL METHOD OF INVESTIGATING [illegible]TO-FIELDS. L.N.Malakhov and Yu.V.Vorob'ev. [illegible] Akad. Nauk. SSSR, Vol. 125, No. 2, 315-16 (1959). In Russian.
Describes a method of observing the potential distribution at [illegible]urface of a semiconductor. The semiconductor is placed at [illegible]ocus of an electron microscope and a schlieren image is prod-[illegible]s at the final screen. The potential distribution at a p–n junction [illegible]germanium crystal is shown. T.Mulvey

537.311.33

27. DETERMINATION OF THE SURFACE CONDUCTIVITY OF [illegible]ICONDUCTING CRYSTALS BY THE "WEDGE" METHOD. [illegible]Rubinshtein and V.I.Fistul'. [illegible]. Akad. Nauk SSSR, Vol. 125, No. 3, 542-5 (March 21, 1959). [illegible]ussian.
Two-probe electrical conductivity measurements are made on [illegible]dge-shaped specimen with small included angle ($\leq 7^0$) and [illegible]apolated to zero wedge thickness to obtain the specific surface [illegible]uctivity. The method is extended to include the case where the [illegible] material is inhomogeneous. Results are presented for ger-[illegible]ium. The method is also stated to be applicable to silicon. C.H.L.Goodman

537.311.33

28. THEORY OF SURFACE CURRENTS AT SEMICONDUCTOR [illegible]FACES. E.Groschwitz and R.Ebhardt. [illegible]ngew. Phys., Vol. 11, No. 8, 296-304 (Aug., 1959). In German.
The inversion layers at semiconductor surfaces are investigated. [illegible]ial attention is paid to the surface currents and their dependence [illegible]emiconductor parameters, diffusion effects, recombination, etc. [illegible]mple model is used as a basis for these calculations. P.T.Landsberg

537.311.33

29. FIELD-EFFECT THEORY. I.V.Boiko. [illegible] tverdogo Tela, Vol. 1, No. 1, 13-15 (Jan., 1959). In Russian.
Bonch-Bruevich's "microscopic" theory of the field effect in [illegible]iconductors (Abstr. 7927 of 1958) applies in the case when the [illegible]ye length l_D and the carrier mean free path l are comparable. [illegible]shown that in the limiting case, as $l \to 0$, Bonch-Bruevich's [illegible]ry yields the same result for the density of electrons induced [illegible]n external field as that deduced by Yunovich in his "macro-[illegible]pic" theory (Abstr. 7926 of 1958). It is concluded that the [illegible]croscopic" theory results are valid when (1) $l \ll l_D$ and (2) the [illegible]rgy band curvature at the semiconductor surface is small. A.Tybulewicz

537.311.33

30. THE MECHANISM OF LONG PERIOD INCREASES IN THE [illegible]LD EFFECT. V.I.Lyashenko and N.S.Chernaya. [illegible]. tverdogo Tela, Vol. 1, No. 6, 878-85 (June, 1959). In Russian.
Experiments on time dependence of field effect in germanium [illegible] and n-type) under pressures down to 10^{-9} mm Hg. Field effect [illegible]reases with time, generally reaching saturation in tens of [illegible]nutes. Conditions for appearance of this increase are elucidated [illegible]d explained in terms of the desorption of ions from the semi-[illegible]nductor surface. R.Berman

537.311.33

13291. FIELD EFFECT ON MOLYBDENITE. I.Nakada. J. Phys. Soc. Japan, Vol. 13, No. 12, 1547 (Dec., 1958).
For cleaved surfaces of n-type (carrier density $\sim 10^{18}$ per cm^3) specimens the relationship between the change in conductivity with applied field is linear, but for chemically treated specimens, where the surfaces are probably covered with an electronegative layer, it is nonlinear. The density and energy of the traps are deduced. G.C.Williams

537.311.33 : 541.183

13292. THE CHARGING OF THE SURFACES OF OXIDE SEMICONDUCTORS IN THE ADSORPTION OF GASES AND VAPOURS. Z.Kh.Enikeev, L.Ya.Margolis and S.Z.Roginskii. Dokl. Akad. Nauk SSSR, Vol. 124, No. 3, 606-8 (1959). In Russian.
The adsorption of O_2, H_2, CO, CO_2, C_3H_6, isopropyl alcohol on ZnO, NiO, V_2O_5 and CuO was studied with a vibrating plate condenser (measurements of contact potential), at room and elevated temperatures after preliminary treatment for oxygen desorption. All the semiconductors were negatively charged by O_2, the other gases either being not adsorbed, or producing a positive charge (decreased work function). The nature of the adsorption (physical or chemical) in certain cases is discussed. R.C.Murray

537.311.33 : 539.61

ROLE OF THE SURFACE PROPERTIES OF A SEMICONDUCTOR IN ADHESION PHENOMENA. See Abstr. 12844

537.311.33 : 539.12

ABSORPTION OF BETA-RAYS IN SEMICONDUCTORS. See Abstr. 12543

537.311.33 : 539.21

SPECTRAL DEPENDENCE OF THE QUANTUM EFFICIENCY OF HOMOPOLAR CRYSTALS. See Abstr. 12804

537.311.33

13293. ANISOTROPIC CONDUCTIVITY OF CdS SINGLE CRYSTALS. S.Tanaka, M.Kobayashi and T.Masumi. J. Phys. Soc. Japan, Vol. 14, No. 1, 104 (Jan., 1959).
Describes preliminary measurements, at room temperature of the conductivity σ of Cl-doped n-type CdS by observing changes in the Q values of a cavity in the 9 500 Mc/s range. Values of σ parallel to the c-axis are almost twice those perpendicular to it. G.C.Williams

537.311.33

13294. ELECTRICAL CONDUCTIVITY OF Cu_2O IN AIR IN THE REGION OF ITS STABILIZATION (1020-1070° C). I. K.P.Zuev. Fiz. tverdogo Tela, Vol. 1, No. 1, 124-33 (Jan., 1959). In Russian.
The electrical conductivity of Cu_2O was measured in the region 800-1070° C under atmospheric conditions. The activation energy found from the temperature dependence of the electrical conductivity, which rose with temperature from 0.1 to 10 $ohm^{-1}cm^{-1}$, was 1.9-2.0 eV. The latter value was somewhat higher than the values reported so far but it agreed better with the optical propertues of Cu_2O. A.Tybulewicz

537.311.33

13295. ELECTRICAL CONDUCTIVITY OF Cu_2O IN ITS DISSOCIATION REGION (1070-1250° C). II. K.P.Zuev. Fiz. tverdogo Tela, Vol. 1, No. 1, 134-41 (Jan., 1959). In Russian.
The electrical conductivity of Cu_2O was measured in the region 1070-1250° C under atmospheric conditions; its value was between 10 and 100 $ohm^{-1}cm^{-1}$. Two critical regions were found: one at 1070° C where the temperature coefficient of the electrical conductivity rose sharply and the other at about 1200° C where the temperature coefficient changed sign (melting starts near 1200° C). It was found that the electrical conductivity of Cu_2O between 800° and 1250° C is related directly to the dissociation vapour pressure of this compound. A.Tybulewicz

537.311.33 : 621.315.59

13296. ON THE BREAKDOWN IN P–N TRANSITIONS IN GERMANIUM. B.M.Wul. Semiconductors and phosphors (see Abstr. 9597 of 1959) pp. 647-9. In German.
Evidence is presented which suggests that the electrical breakdown of p–n layers in germanium is analogous to avalanche breakdown in, for example, air. The breakdown voltage U depends under normal conditions on the concentration N of current carriers according to the formula $U = cN^{-0.64}$, where c is a constant. P.T.Landsberg

537.311.33 : 535.337

13297. RECOMBINATION EMISSION CAUSED THROUGH THE PRESENCE OF IMPURITIES IN GERMANIUM.
A.Gosnet, O.Parodi and C.Benoit à la Guillaume.
C.R. Acad. Sci. (Paris), Vol. 248, No. 11, 1628-31 (March 16, 1959). In French.

Radiation from Sb-doped Ge crystals was studied. Emission took place at three distinct energies, two of these at 0.707 and 0.734 eV were attributed to direct recombination and to recombination caused by the presence of impurity levels. The third emission at 0.714 eV was independent of the crystal impurity content and was possibly caused by the indirect recombination of an exciton.
W.G.Townsend

537.311.33

13298. THE EFFECT OF TEMPERATURE ON THE RATE OF RECOMBINATION OF ELECTRONS AND HOLES ON COPPER ATOMS IN GERMANIUM.
N.G.Zhdanova, S.G.Kalashnikov and A.I.Morozov.
Fiz. tverdogo Tela, Vol. 1, No. 4, 535-44 (April, 1959). In Russian.

The temperature dependence of the hole lifetime in n-type germanium with copper atoms as recombination centres was considered. It was found that, in samples with comparatively large amounts of copper the hole lifetime, and consequently the hole capture cross-section of the upper level of copper, depends weakly on temperature. In samples with comparatively small amounts of copper the hole lifetime depended strongly on temperature. It was found also that the hole capture cross-section of triply charged copper ions was larger than that of doubly charged ions. The observed temperature dependences of the hole lifetime agreed well with deductions from the theory of recombination on multiply charged centres.
A.Tybulewicz

537.311.33

13299. RECOVERY OF PROPERTIES OF GERMANIUM BY ANNEALING IN ANTIMONY AND ARSENIC. N.I.Chetverikov.
Fiz. tverdogo Tela, Vol. 1, No. 4, 553-5 (April, 1959). In Russian.

Rapid cooling of a germanium sample heated to over 500°C decreases carrier lifetime and increases acceptor density. The same effects are observed on covering germanium with copper and holding it at 800°C for a time sufficiently long to ensure uniform diffusion of copper throughout the sample. The author found that the original properties of n-type Sb-doped germanium can be either completely or partly recovered by annealing in antimony or arsenic vapours at 800°C, for 28 or 12 hours respectively, and by subsequent quenching.
A.Tybulewicz

537.311.33

13300. THE BEHAVIOUR OF GERMANIUM-TYPE VALENCE CRYSTALS IN STRONG ELECTRIC FIELDS. V.A.Chuenkov.
Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 22, No. 4, 363-8 (1958). In Russian. English summary: PB 141041T-4, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

A theoretical investigation of the distribution function of the conduction electrons in a strong electric field. An expression is obtained which relates the electron energy to the field at which electron avalanche occurrs in a homogeneous semiconductor. A comparison is made between the theory and experimental results on the breakdown at abrupt p–n junctions in germanium and silicon.
W.Bardsley

537.311.33 : 537.312.9

13301. PIEZORESISTANCE OF N-TYPE GERMANIUM.
H.Fritzsche.
Phys. Rev., Vol. 115, No. 2, 336-45 (July 15, 1959).

The change of electrical resistance in uniaxial tension was measured over the range 6° to 300°K for several single-crystal specimens of germanium doped with arsenic or antimony. The tensile stress was varied from 1×10^7 to 5×10^8 dynes/cm^2. Particularly at low temperatures where most of the carriers are bound to impurity centres, the piezoresistance of the conduction band departs strongly from linearity in stress. For the large piezoresistance effects measured with uniaxial stress in [110] direction, these departures depend in size and magnitude on the kind of donor impurity. It is shown that if the strain-induced shift of the Fermi energy is taken into consideration these effects are to be expected from the electron transfer model, which attributes the large piezoresistance to the strain-induced changes of the electron concentrations in the various conduction band valleys. Theoretical predictions concerning the lowest donor states — a one-fold 1s-like ground state and a higher lying threefold state — are verified for As in Ge. The energy separation between these two states is $(4.10 \pm 0.15) \times 10^{-3}$ eV for As and at least by an order of magnitud smaller for Sb in Ge. The deformation potential constant (conduction band) for pure shear strain was found to be $E_s = 19.2 \pm 0.4$ eV at 6.6°K. The mobility anisotropy of a valley was found to decrea with decreasing T because of anisotropic scattering by ionized impurities.

537.311.

13302. NERNST AND ETTINGSHAUSEN EFFECTS IN GERMANIUM BETWEEN 300 AND 750°K.
H.Mette, W.W.Gärtner and C.Loscoe.
Phys. Rev., Vol. 115, No. 3, 537-42 (Aug. 1, 1959).

The Nernst and Ettingshausen effects in germanium single crystals of different conductivity type and with various impurity densities have been measured between 300 and 750°K in magnetic fields of 9000 G; the Nernst effect also at 2100 G. The experimen results are compared with theoretical expressions for the Nernst and Ettingshausen coefficients and with previously reported values for the thermal conductivity, which links the two effects through the Bridgman relationship. The qualitative agreement is very goo quantitative discrepancies are explained in terms of deviations of the sample mobilities from the theoretically assumed pure low-fie lattice mobilities and by uncertainties in the numerical values use for the theoretical calculations. A derivation of the Nernst consta in the range of negligible phonon-drag effect is given, based on the analogy between thermo- and photomagnetoelectric effects.

537.311.

13303. ROLE OF IMPURITIES IN THE HEAT TREATMENT EFFECTS OBSERVED IN INDIUM ARSENIDE.
J.R.Dixon and D.P.Enright.
J. appl. Phys., Vol. 30, No. 9, 1462-3 (Sept., 1959).

Additional evidence has been obtained to show that the changes in carrier concentration produced by heat treatment are due to impurities. The treatment has been applied to samples of InAs obtained from different laboratories and the differing results show that the changes are not an intrinsic property of the material.
D.J.Olive

537.311.33 : 539.

P–N JUNCTIONS OF InP AS NEUTRON DETECTORS. See Abstr. 12563

537.311.

13304. ELECTRICAL CONDUCTIVITY IN N TYPE InSb UNDER STRONG ELECTRIC FIELD. Y.Kanai.
J. Phys. Soc. Japan, Vol. 13, No. 8, 967-8 (Aug., 1958).

Hall coefficient measurements confirm that the observed devi tion of the I–V characteristic from Ohm's law, at 200 V/cm compared with a predicted value of 6 V/cm, arises from loss of energ by electron interaction with optical rather than with acoustic mode of vibration. Carrier ionization is observed to set in at an electro drift velocity of about 2×10^7 cm/sec.
G.C.Willian

537.311.3

13305. RECOMBINATION PROCESSES IN P-TYPE INDIUM ANTIMONIDE. R.N.Zitter, A.J.Strauss and A.E.Attard.
Phys. Rev., Vol. 115, No. 2, 266-73 (July 15, 1959).

Photoelectromagnetic and photoconductive lifetimes were measured from 77° to 300°K in monocrystalline p-type indium antimonide of net acceptor concentration ranging from less than 10^{15} cm^{-3} to 10^{18} cm^{-3}. It is concluded that at the lower temperatures, excess electrons are trapped in immobile states in the forbidden band and that the trap concentration is the same in all samples, regardless of net acceptor concentration. At intermedia temperatures, trapping becomes negligible but recombination continues to take place through states in the forbidden gap; there i some reason to believe that in this temperature region lifetimes are determined by more than one level of forbidden-band states. At still higher temperatures, where the samples are intrinsic, the lifetime data are consistent with the hypothesis of a direct inter-band Auger recombination process.

537.311.

13306. ELECTRON DAMAGE THRESHOLDS IN InSb.
F.H.Eisen and P.W.Bickel.
Phys. Rev., Vol. 115, No. 2, 345-6 (July 15, 1959).

Measurements of carrier removal rate and isochronal recove in electron-irradiated InSb indicate that displacements are produc at electron energies as low as 240 keV. Two recovery stages wer

and the activation energies for recovery determined. The activity recovery in the low-temperature stage was found to be order.

537.311.33 : 548.5

A RELIABLE METHOD FOR THE PRODUCTION OF HIGH TY INDIUM ANTIMONIDE. See Abstr. 13896

537.311.33 : 621.314.634

ELECTRICAL FORMING EFFECTS OF LEAD SELENIDE LEAD TELLURIDE RECTIFIERS. S.Uchiyama and K.Shōgenji. J. Japan, Vol. 4, No. 2, 50-4 (June, 1958).

Using current-pulse forming techniques, the authors show that and PbTe can give reasonable room-temperature rectification a whisker contact. C.A.Hogarth

537.311.33 : 621.314.63

3. SILICON POWER RECTIFIERS. E.Spenke.
conductors and phosphors (see Abstr. 9597 of 1959) pp. 630-40. erman.

Reviews the basic principles, presents some resistivity and life- data from production runs of Si monocrystal material, shows a rosection through a junction diode, and shows the characteristics some applications. F.F.Roberts

537.311.33 : 669 : 621.315.59

9. BONDING MATERIALS FOR MAKING CONTACTS TO YPE SILICON. D.R.Mason and J.C.Sarace.
lectrochem. Soc., Vol. 105, No. 10, 594-8 (Oct., 1958).

Molybdenum clad on one side with aluminium, or Al–Si eutectic, been used to form structurally sound ohmic contacts to p-type con, although a flux was necessary when the Al–Si eutectic-clad erial was used. The desired Al–Si solid solution can be formed re a substantial amount of aluminium reacts with the molyb- um. The coefficients of thermal expansion are sufficiently well ched so that the silicon wafer does not crack during fabrication, only minimal alloy penetration into the silicon is observed with eutectic-clad material. Nickel and iron-base metals were found e unsatisfactory, and process troubles with indium ruled out its ce as a bonding agent. Materials produced by cladding with troplating processes, vacuum evaporation, direct sintering, or ing operations, either with or without a dipping flux, were unsatis- ory and only roll-clad products could be used successfully.

537.311.33

10. MEASUREMENT OF CARRIER LIFETIME IN SILICON NOCRYSTALS WITH HIGH FREQUENCIES. W.Keller.
ngew. Phys., Vol. 11, No. 9, 351-2 (Sept., 1959). In German.

A modification of the light-pulse photoconductor decay method escribed, in which instead of using a d.c. bias, insulated pick-up acts and a high-frequency supply are used. The τ value is ined from the oscilloscope decay curve in the usual way. The hod seems reliable for Si of resistivity between 150 and 3000 cm, and has the advantage of eliminating contact-potential injection effects often found in the conventional method. C.A.Hogarth

537.311.33 : 539.217

THE DIFFUSION OF IMPURITIES IN SILICON. See tr. 12813

537.311.33 : 539.217

DIFFUSIVITIES OF DONORS AND ACCEPTORS IN Si BY DIOTRACERS. See Abstr. 12816

537.311.33 : 548.5

CLEANING OF SILICON SURFACES BY HEATING IN HIGH CUUM. See Abstr. 13892

537.311.3 : 539.2

RESIDUAL RESISTANCE MEASUREMENT OF SINTERED NGSTEN BARS. IMPURITY DETECTION. See Abstr. 12773

537.311.33

11. MODULATION OF THE DIFFUSION LENGTH AS A NEW RKING PRINCIPLE OF SEMICONDUCTING DEVICES.
Stafeev.
tverdogo Tela, Vol. 1, No. 6, 841-7 (June, 1959). In Russian.

A theoretical analysis [Stafeev, Fiz. tverdogo Tela, Vol. 28, (1958)] of the properties of diodes with a large d/L ratio showed rong dependence of the d.c. current of these diodes on the diffu- length. Small changes of L led to relatively large changes of rent. On the principle of modulation of the diffusion length, new s of diodes were produced having (a) high sensitivity to magnetic fields, (b) a region of negative resistance, (c) high photosensitivity (to 100 A/lm). On the same basis a new amplifier is proposed. The mechanism of current multiplication and a new mechanism of photosensitivity of diodes are used to explain the results of germanium diodes doped with Au and Fe. D.J.Huntley

537.311.33

13312. CURRENT—VOLTAGE CHARACTERISTICS OF AN ELECTROLYTE—SEMICONDUCTOR JUNCTION.
Yu.A.Vdovin, V.G.Levich and V.A.Myamlin.
Dokl. Akad. Nauk SSSR, Vol. 124, No. 2, 350-3 (1959). In Russian.

The phenomena occurring at the n-type semiconductor—electrolyte interface were analytically studied, and expressions for the forward and reverse current—voltage characteristics of this junction were derived for the case when the passage of the electric current is accompanied by an oxidizing-reducing reaction of the $A^+ + e^- \rightleftharpoons A$ type. M.H.Sloboda

537.311.33 : 621.382.2

13313. THE CURRENT—VOLTAGE CHARACTERISTICS OF DIODES UNDER EXTREMELY HIGH INJECTION RATES.
V.I.Stafeev.
Fiz. tverdogo Tela, Vol. 1, No. 6, 848-50 (June, 1959). In Russian.

At very high injection rates the current—voltage characteristic derived earlier (Abstr. 5717 of 1959) is reduced to the form $V = V_k + I.R$, where V_k is the contact potential and R the resistance of the n region. The expression for R gives a value of $1.5 \times 10^{-4}\ \Omega$ compared with an experimental value of $10^{-4}\ \Omega$ for a diode used by Hall [Abstr. 428B of 1953; Proc. Inst. Radio Engrs, Vol. 40, 1512-18 (Nov., 1952)]. D.J.Huntley

537.311.33

13314. THEORY OF THE PULSE METHOD OF VOLTAGE SEPARATION IN SEMICONDUCTOR DIODES. Yu.K.Barsukov.
Fiz. tverdogo Tela, Vol. 1, No. 6, 886-94 (June, 1959). In Russian.

Shows theoretically that the diode voltage can be considered as the sum of an ohmic and a diffusional component if the p–n transition and base layer boundary is equipotential, and the rear contact surface is a surface of equal charge carrier concentration. In this case the pulse method enables the total voltage to be split into the two components, which enables the excess charge carrier concentration in the base layer to be predicted and an individual p–n transition V–I characteristic to be obtained when the diffusion voltage in the base layer is small compared with the p–n transition voltage. Accurate measurements require a current change length considerably less than the charge-carrier life and the mean time of carrier diffusion across the base layer, whilst the charge passed through the diode by the current increase during the current change must be small compared with the total charge of the minority carriers contained in the base layer. Expressions are included for the measurement error in these conditions. D.E.Brown

537.311.33 : 621.319.4

13315. ALLOYED, THIN-BASE DIODE CAPACITORS FOR PARAMETRIC AMPLIFICATION. K.E.Mortenson.
J. appl. Phys., Vol. 30, No. 10, 1542-8 (Oct., 1959).

The design of double alloyed, thin-base diode capacitors for parametric amplification is described, which indicates that capacitors with maximum Q's well in excess of 200 at 1 kMc/s and capacitive swings in excess of 15 are obtainable. The high Q's resulting from the type of fabrication and the small base thickness used; the large capacitive swing resulting from the abrupt p^+n junction created. Three figures of merit are defined and evaluated: (1) an over-all device figure, F_D, proportional to the product of the maximum Q and capacitance ratio evaluated in terms of material parameters, degree of base doping, and geometry factors; (2) a Q factor, F_Q, proportional to just the capacitor Q; and (3) a material factor, F_M, by which different materials used for fabrication can be compared. Fixing the choice of material (with germanium shown to be superior to silicon for this purpose) and achieving the best geometry, F_D and F_Q are examined as a function of doping. It is shown that F_Q is nearly constant over the entire practical range of doping while F_D, because of the capacitive swing, increases substantially with lighter doping. Results are presented for units with all soldered connections (no pressure contacts) fabricated from double alloyed pellets with a p^+nn^+ structure. To date, diode capacitors with maximum Q's in excess of 200 at 1 kMc/s and with capacitive swings in excess of 10 have been made. It is anticipated that this fabrication process will yield Q's in excess of 500 at 1 kMc/s with closer alloying control.

537.311.33

13316. CALCULATION OF TRANSIENT PROCESSES IN TRANSISTORS. A.A.Grinberg.
Fiz. tverdogo Tela, Vol. 1, No. 1, 31-43 (Jan., 1959). In Russian.

Transient conductivity of a transistor was calculated allowing for the finite value of the internal resistance, the effect of the e.m.f. source, the collector capacitance and the load impedance. This transient characteristic is a rapidly converging series suitable for use in Duhamel's integrals. Nonlinear working conditions were also considered and dependence of the active load current on time was derived (in both cases the base was assumed to be grounded).
A.Tybulewicz

537.311.35

13317. THE ELECTRICAL CONDUCTIVITY OF MOLTEN SILICA. M.B.Panish.
J. phys. Chem., Vol. 63, No. 8, 1337-8 (Aug., 1959).

Briefly describes apparatus and technique used for determining the electrical conductivity of silica (< 0.045% impurity) over the temperature range 1500°C-2500°C (molten). Results are given graphically together with those of earlier workers. Possible sources of error are discussed. E.G.Knowles

537.312.5

13318. POLARIZATION PROCESSES IN PARTIALLY ILLUMINATED PHOTOCONDUCTING INSULATORS. M.Y.Ben Sira, B.Pratt, E.Harnik and A.Many.
Phys. Rev., Vol. 115, No. 3, 554-9 (Aug. 1, 1959).

A quantitative analysis of polarization phenomena in photoconducting insulators is presented for the case in which a strip of the sample is illuminated far from the electrodes. It is shown that if the drift length of the photo-excited carriers is small compared with the dimensions of the dark and illuminated regions, the photocurrent decays exponentially during both the buildup and release of polarization. The decay constant is essentially independent of the characteristics of the contacts and the applied voltage, and can be expressed in terms of geometrical factors and the photoconductance of the illuminated strip. The conclusions of the analysis are checked in coloured single crystals of NaCl. The experimental results are found to be in satisfactory agreement with the theory presented.

537.312.5

13319. INDUCTION PHENOMENA IN PHOTOCONDUCTING SINGLE CRYSTALS. W.Thielemann and K.Kreher.
Z. Naturforsch., Vol. 14a, No. 7, 687-8 (July, 1959). In German.

Charges induced on CdS and ZnS crystals were detected by their deflection of an electron beam. Negatively charged crystals retained their charge for a long time in the dark, whereas a positive charge was rapidly lost. The effect of traps is discussed.
J.Franks

537.312.5

13320. GRAIN BOUNDARY PHOTO-DETECTOR. W.W.Lindemann and R.K.Mueller.
J. appl. Phys., Vol. 29, No. 12, 1770-1 (Dec., 1958).

An arrangement for utilizing a low-angle grain boundary in germanium as a radiation detector is described. The response time of such a detector may be adjusted electronically.
C.A.Hogarth

537.312.5 : 771.534

SPECTRAL SENSITIVITY OF AgBr PHOTOCELLS. See Abstr. 12927

537.312.5

13321. ON THE INFLUENCE OF GASES AND VAPOURS ON THE PHOTOCONDUCTION AND DARK CONDUCTIVITY OF THIN LEAD SULPHIDE LAYERS. K.E.Boeters, H.Gobrecht and F.Niemeck.
Semiconductors and phosphors (see Abstr. 9597 of 1959) pp. 577-80. In German.

The effect of permanent gases is in general found to arise from their adsorption on the semiconductor surface and is indicated by a transient alteration in the equilibrium between gas pressure and photoconduction or dark conduction. All gases behave qualitatively in the same way and no charge exchange between gas molecules and semiconductor seems to occur. G.F.J.Garlick

537.312.5 : 537.226.3

ANISOTROPIC PHOTOCONDUCTIVITY OF SULPHUR. INFLUENCE ON PHOTOELECTRET PROPERTIES. See Abstr. 12226

537.312

13322. SATURATED PHOTOCURRENTS IN HEXAGONAL SELENIUM. M.Polke, G.Storch and F.Stöckmann.
Z. Phys., Vol. 154, No. 1, 51-61 (1959). In German.

Theoretical considerations suggest that the photocurrents in selenium might become saturated with respect to voltage due to space charge limitation. The photoconductivity of vacuum-deposi thin films of hexagonal Se was therefore studied in some detail ov the temperature range 20° to -180° C. Although saturated photocurrents were observed at all temperatures at sufficiently high fields, it could not be decided whether these were in fact space charge limited. K.W.Pless

537.312.5 : 535.3

13323. SOME ELECTRICAL AND OPTICAL PROPERTIES OF TI MONOSULPHIDE. T.Yabumoto.
J. Phys. Soc. Japan, Vol. 13, No. 8, 972-3 (Aug., 1958).

Measurements of optical absorption and photoconductivity on thi films of SnS indicate a band gap of approximately 1.6 eV. The temperature dependence of the conductivity, measured for bulk crystalline material, indicates an impurity level in the forbidden D.L.Greenaw

537.31

13324. AN INTERNAL PHOTOEFFECT IN A FUSED CHALCOGENIDE GLASS. B.T.Kolomiets and T.N.Mamontova.
Dokl. Akad. Nauk SSSR, Vol. 125, No. 1, 73-4 (March, 1959). In Russian.

A successful attempt to detect photoconductivity in an inorga liquid. The amorphous (vitreous) semiconductor $4As_2Se_3.As_2Te_3$ was studied to temperatures above its softening point (156°C). N essential change in photoconductive response spectrum was observed between room temperature and 184°C; above this temperature high noise level hindered measurements. The existence of photoconductivity in a liquid is considered as further confirmation of the suggestion, due to Ioffe [Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 15, 64, 477 (1951)], that semiconductivity is a function of short-range rather than long-range order.
C.H.L.Goodm

537.312.62 : 621.318

13325. HIGH-SPEED SUPERCONDUCTIVE SWITCHING ELEME SUITABLE FOR TWO-DIMENSIONAL FABRICATION. V.L.Newhouse and J.W.Bremer.
J. appl. Phys., Vol. 30, No. 9, 1458-9 (Sept., 1959).

The arrangement described consists of two nearby metal film one of tin and one of lead, obtained by vacuum deposition, insulate from each other, and so arranged that a current can be passed al the tin film (called the "gate") at right angles to a current along t lead film (called the "grid"). This device is operated just below the critical temperature for tin. Current through the lead film th serves to control the current through the tin film by magnetic con trol of the superconductive transition. Experimentally found chara cteristics are given and compared with theory, showing reasonabl agreement. The uses of the device as a computer element are briefly discussed and time constants of a few microseconds are fe to be possible. It is suggested that the device could, as a memory device, greatly increase the performance capabilities of digital computers. L.Mackinn

537.312.6

13326. SUPERCONDUCTIVITY OF A CHARGED IDEAL 2-DIMENSIONAL BOSE GAS. R.M.May.
Phys. Rev., Vol. 115, No. 2, 254-62 (July 15, 1959).

It is well-known that the 2-dimensional Bose gas does not condense, and that no transition occurs in its thermodynamic behaviour. Despite this, we find that in a magnetic field a 2-dimensional gas of charged, ideal bosons has a nearly sharp trans ition temperature, below which it displays an "imperfect" Meissne Ochsenfeld effect, practically indistinguishable from the perfect London one. This fact is relevant to the application of the Bose ga model of superconductivity to thin films. The main interest of the model is, however, that it exhibits an (essentially perfect) Meissn Ochsenfeld effect without any irregularity in $C_V(T)$.

537.312.62 : 534.

13327. EVIDENCE FOR ANISOTROPY OF THE SUPERCONDUC ING ENERGY GAP FROM ULTRASONIC ATTENUATION. R.W.Morse, T.Olsen and J.D.Gavenda.
Phys. Rev. Letters, Vol. 3, No. 1, 15-16 (July 1, 1959); erratum No. 4, 193 (Aug. 15, 1959).

The results given are of ultrasonic absorption measurements ingle crystals of pure tin in the temperature range 1.00°K to °K (the transition temperature). Longitudinal waves of fre- cies up to 80 Mc/s were used — these are high enough to make electron mean free path large compared with the sound wave- th — and different directions of propagation were studied. It is ted out that differences in the results for different directions be interpreted in part as due to variations over the Fermi sur- of the energy gap now associated with the superconducting state; ting energy gap for various propagation directions are deduced e as follows: [001], $(3.5 \pm 0.1)kT_c$, [100]; $(4.3 \pm 0.2)kT_c$; and], $(3.8 \pm 0.1)kT_c$. The relevant portion of the Fermi surface is oss-section at right angles to the propagation direction and it is ested that in fact more than one energy gap may be involved.

L.Mackinnon

537.312.62 : 536.212.2

THERMAL CONDUCTION OF SUPERCONDUCTORS. See tr. 13208

537.312.62 : 536.631

SPECIFIC HEAT MEASUREMENTS AND THE ENERGY P IN SUPERCONDUCTORS. See Abstr. 13237

537.312.7

28. SURFACE STATES IN METALS.
onfiglioli and R.Malvano.
s. Rev., Vol. 115, No. 2, 330-5 (July 15, 1959).

For previous work, see Abstr. 378, 3715 (1956). Highly accurate surements were made of conductivity modulation in metals by an tric field. Au, Sb, and Bi films were studied at temperatures ween about −20 and +80°C. The existence of localized and con- ding "surface states" at the metal/dielectric interface seems to xperimentally confirmed.

537.312.8

29. NEW EXPERIMENTAL RESULTS CONCERNING THE LL EFFECT IN THIN FILMS OF NICKEL.
olombani and G.Goureaux.
. Acad. Sci. (Paris), Vol. 249, No. 3, 381-3 (July 20, 1959).
French.

The results of Hall effect measurements made on thin evapora- nickel films in the temperature range from 20° to 400°C, are orted. Room temperature measurements have been made of the iation of Hall voltage with applied magnetic field, for a range of cimen thicknesses from 22 to 605 A. In addition, Hall effect therms have been obtained over the whole temperature range films of thickness 58 and 460 A. The results of both these ies of measurements are discussed and compared with the ults of earlier measurements (Abstr. 6046-7 of 1958; 2496, 6, 4626 of 1959). S.A.Ahern

537.312.8

30. THE HALL CONSTANTS OF THIN FILMS OF NICKEL.
oureaux and A.Colombani.
. Acad. Sci. (Paris), Vol. 249, No. 4, 511-13 (July 27, 1959).
French.

Results are reported of measurements on films of thickness n 22 to 600 A and in the temperature range from 20° to 400°C. behaviour of films less than 180 A thick shows marked differ- es from thicker films. C.A.Hogarth

537.312.8

31. HALL EFFECT AND SELF HALL EFFECT IN NORMAL D SUPER-CONDUCTORS. R.Jaggi and R.Sommerhalder.
v. phys. Acta, Vol. 32, No. 3, 167-96 (1959). In German.

The Hall effect (in an external transverse magnetic field) and self Hall effect (in the self-field of the primary current) are ated phenomenologically. The Hall potential is calculated at inside and outside of a cylindrical specimen. Special arrange- nts for plates and cylinders are given, also a circuit for the asurement of the Hall effect and the self Hall effect, and an a.c. npensation method for the determination of resistance, Hall ect and the change of resistance in a magnetic field. Measure- nts carried out at room temperature with a cylindrical p-InSb gle crystal give identical results for the Hall and self Hall effect. e self Hall effect is measured at liquid helium temperature with ycrystalline specimens of Cu and Hg. The problem of the Hall ect in superconductors is discussed. Experiments by the authors the Hall effect in Pb and Sn in the presence of screening currents on the self Hall effect in Hg give no potentials above 10^{-9} V n to 2°K in the completely superconducting isothermal condition.

H.London

537.312.8

13332. THE HALL EFFECT AT THE CURIE POINT.
N.S.Akulov and A.V.Cheremushkina.
Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 518-19 (Aug., 1958). In Russian. English translation in Soviet Physics—JETP (New York), Vol. 35(8), No. 2, 357-8 (Feb., 1959).

Depending on the specimen temperature in relation to the Curie point, the magnetization of ferromagnetics may occur in four distinct ways. It is shown from experiments on Fe—Al alloys that a different Hall constant is appropriate in each case. The theory of the processes is outlined. C.A.Hogarth

537.312.8

13333. A NOTE ON THE MAGNETORESISTANCE EFFECT OF STRAIN GAUGE WIRE. H.Takaki and T.Tsuji.
J.Phys. Soc. Japan, Vol. 13, No. 11, 1406 (Nov., 1958).

The variation of the magnetoresistance of constantan with temperature is measured. The results are in good agreement with the observation that the decrease in electrical resistance with external field is proportional to the square of the effective magnetiza- tion. G.C.Williams

537.312.8

13334. ANISOTROPY OF THE ELECTRICAL RESISTANCE OF A GOLD MONOCRYSTAL IN A MAGNETIC FIELD AT 4.2 °K.
N.E.Alekseevskii and Yu.P.Gaidukov.
Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 554-5 (Aug., 1958).
In Russian. English translation in : Soviet Physics—JETP (New York), Vol. 35(8), No. 2, 383-4 (Feb., 1959).

The electrical resistance r_H of a gold monocrystal was deter- mined at 4.2 °K as a function of the direction of a magnetic field H, which was rotated in a plane perpendicular to the fourth-order axis of the crystal. At the maxima of the polar diagram thus obtained, $(r_H - r_0)/r_0$, where r_0 is the resistance with no magnetic field, varies as $H^{1.8}$; at the minima, $(r_H - r_0)/r_0$ saturates with increasing H. The anisotropy of resistance may be associated with the existence of an open Fermi surface for gold. C.H.B.Mee

537.312.8

13335. MEASUREMENT OF THE ELECTRICAL CONDUCTIVITY OF METALS IN A MAGNETIC FIELD AS A METHOD FOR INVESTIGATION OF THE FERMI SURFACE.
N.E.Alekseevskii and Yu.P.Gaidukov.
Zh. eksper. teor. Fiz., Vol. 36, No. 2, 447-50 (1959). In Russian.

Results of investigation of the polar diagrams of the resistance of samples of Sn, Pb, Tl, Ga and Na single crystals are presented. It was found that with variation of the angle between the field and crystallographic axes of Sn and Pb (and analogously Au and Cu) the law of increase of the resistance in a magnetic field changes from a quadratic form to that of saturation. A strong anisotropy of the resistance in a magnetic field was also observed in Tl and Ga. The results are ascribed to the presence of open Fermi surfaces in these metals.

537.322

13336. IRREVERSIBLE THERMODYNAMICS AND KINETIC THEORY IN THE DERIVATION OF THERMOELECTRIC RELA- TIONS. J.W.Leech.
Canad. J. Phys., Vol. 37, No. 9, 1044-54 (Sept., 1959).

The variety of experimental behaviour found in thermoelectric- ity at low temperatures provides an incentive for extending the theoretical treatment. In the past, irreversible thermodynamics was used to provide a satisfactory derivation of the Thomson rela- tions. It appears that what one might call a general "primary equa- tion" of thermoelectricity can be derived from irreversible thermo- dynamics, and that this should be of direct use in kinetic discussions. The form of the equation suggests that an even more direct approach to the thermoelectric problem should be possible.

537.323

13337. LOW TEMPERATURE THERMOELECTRIC POWER OF Cu—Mn ALLOYS. S.Tanuma.
J. Phys. Soc. Japan, Vol. 14, No. 4, 541 (April, 1959).

The graph of absolute thermoelectric power v. temperature shows a minimum in the same way as for resistivity.

C.A.Hogarth

ELECTRIC DISCHARGES

537.521

13338. THEORY OF ELECTRIC DISCHARGE IN A MOVING, CONDUCTING MEDIUM V.N.Zhigulev.
Dokl. Akad. Nauk SSSR, Vol. 124, No. 6, 1226-8 (1959). In Russian.

The electric and magnetic vector relations are formulated for the field of a point discharge in a conducting homogeneous medium moving uniformly with an arbitrary velocity, less than that of light in vacuo, but not necessarily less than that of light in the medium. Spectral and angular distributions are predicted, and the conditions for Cherenkov radiation formulated.

537.523.3

13339. A STUDY OF THE HIGH FREQUENCY SPECTRUM OF PERIODIC [CORONA] DISCHARGES. W.Heintz.
Z. angew Phys., Vol. 11, No. 2, 51-7 (Feb., 1959). In German.

Describes a study, by Fourier analysis etc., of the spectrum of "noise" produced during negative point corona of the type described by Trichel. Full experimental data are given. The frequency range was from about 0.2 to 6 Mc/s. Circuit parameters are given in detail for the corona gap etc. J.D.Craggs

537.523.4

13340. BREAKDOWN VOLTAGE AND CATHODE STRUCTURE IN K VAPOUR. G.G.Brătescu.
Rev. de Physique (Bucarest), Vol. 4, No. 1, 33-7 (1959). In German.

Results are given of the variation of sparking potential with vapour pressure and with temperature near the cathode in three parallel plate gaps, two with Al electrodes and the other with a K cathode. The Paschen curves for the three tubes agree except above a value of pressure × distance for which the temperature in one of the tubes is greater than 369°C which is sufficient to remove the K layer from the Al cathode. J.Dutton

537.523.5

13341. EFFECT OF CATHODE INCLUSIONS ON ELECTRICAL DISCHARGES. P.C.L.Pfeil and L.B.Griffiths.
Nature (London), Vol. 183, 1481 (May 23, 1959).

A brief note describing microscopic observations made on cathodes of spark gaps carrying ~ 1.6×10^{-4} A/cm^2 in non-arcing conditions. Preferential vaporization took place around inclusions of relatively low electrical conductivity. J.D.Craggs

537.525.8

13342. A CONTRIBUTION TO THE STUDY OF HIGH-FREQUENCY DISCHARGES IN METHANE.
E.Badareu, D.Ştefănescu and C.Popoviczi.
Rev. de Physique (Bucarest), Vol. 4, No. 1, 5-13 (1959). In French.

Describes experiments made on the dissociation of methane at ~ 600 kc/s. In particular, measurements were made on the production of C_2H_2, for various discharge parameters. J.D.Craggs

537.525.8

13343. ENERGY DISTRIBUTION OF ELECTRONS IN A VERY HIGH-FREQUENCY DISCHARGE IN HYDROGEN. F.Ciorăscu.
Rev. de Physique (Bucarest), Vol. 3, No. 1, 21-32 (1958).

Describes a method for the measurement of the conductivity of a 2.5 Mc/s discharge by the superposition, over part of the discharge, of a weak field (170 Mc/s) produced between two internal electrodes. Probe measurements of electron density, etc., were also made and the results compared with those deduced from the conductivity data. Pressures were between 6×10^{-4} and 5×10^{-2} mm Hg, for discharge currents of 20 - 60 mA. J.D.Craggs

537.527.5

13344. THE MAGNITUDE OF THE EFFECTIVE IONIZATION VOLTAGE [Ve] IN MERCURY HIGH PRESSURE ARCS.
W.Neumann.
Ann. Phys. (Leipzig), Folge 7, Vol. 2, No. 3-4, 168-81 (1958).
In German.

Analyses various methods used to obtain Ve and concludes that the most reliable is that of Abstr. 4512 (1938), 2912 (1939) and Schulz and Weizel, Z. Phys., Vol. 122, 697 (1944), from which a value of 9.8 V at an electron density of 2.9×10^{17} cm^{-3} is obtained — a value in good agreement with theory (Abstr. 2491 of 1948). J.Dutton

537.527.5

13345. EVALUATION OF LATERAL OBSERVATIONS OF CYLINDRICAL ARCS. J.Friedrich.
Ann. Phys. (Leipzig), Folge 7, Vol. 3, No. 5-6, 327-33 (1959).
In German.

Using an integral transform of the Abel type, a simple and accurate approximation is obtained to evaluate the lateral observations of cylindrical arcs. From the observed light density distribution of a cylindrical high-pressure discharge, the radial dependence of emission per unit volume is derived. A sample calculation is carried out for a liquid-cooled, wall-stabilized xenon high-pressure arc. A.E.D.Heylen

537.527.5

13346. THE TEMPERATURE OF SHORT ARCS IN HIGH-PRESSURE XENON. H.Schirmer.
Z. angew. Phys., Vol. 11, No. 9, 357-61 (Sept., 1959). In German.

Describes certain properties of Xe arcs at pressures varying from 10 to 35 atm. Electrical conductivities and certain spectral characteristics, e.g. the emission in the continuous spectrum, are discussed in relation to arc temperatures. J.D.Craggs

537.528

13347. THE ELECTRICAL BREAKDOWN IN LIQUID HELIUM AND LIQUID NITROGEN.
B.S.Blaisse, A.van den Boogaart and F.Erné.
Bull. Inst. Internat. Froid, Annexe 1958-1, 333-40.

Breakdown was measured between a tungsten plane and a tungsten sphere of 5 mm radius, both optically polished, at separations up to 0.3 mm. In liquid He, the highest breakdown field was about 710 kV/cm, at both 4.2 and 1.3°K, though breakdown sometimes occurred at fields down to half this value; in liquid N_2, the highest figure was 1600 kV/cm. R.G.Chambers

537.528 : 534.2

13348. VACILLATING WAVE RESULTS FROM ELECTRIC FIELD AND POWDER FILLED DIELECTRIC.
J.M.Lohse and M.R.Zimmerman.
J. appl. Phys., Vol. 30, No. 9, 1464-5 (Sept., 1959).

With a potential of about 20 kV applied between diametrically opposed pointed electrodes immersed in a viscous epoxy fluid a surface wave-motion was set up when the fluid contained a dispersion of iron particles in the size range 7 to 70 μ. The gap between the electrodes measured 1½ inches. The surface wave moved from one electrode to the other and continued doing so with a wavering and changing motion. High resistance probe measurements showed that most of the potential drop between the electrodes occurred in the moving wave. Although the phenomenon is unexplained it has been established that a certain degree of conductivity is required to produce it. A.E.Kay

537.529

13349. POLARON THEORY OF THE BREAKDOWN OF IONIC DIELECTRICS. Yu.I.Gorkun and K.B.Tolpygo.
Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 22, No. 4, 377-82 (1958). In Russian. English summary : PB 141041T-4, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

Develops a theory of dielectric breakdown of ionic crystals in terms of the theory of polarons due to Pekar, which is believed to be more appropriate than the band theory which has been used by other authors. In alkali halide crystals the polaron level is 0.15-0.2 eV below the conduction band and no activation energy is thus necessary for a transition from this band to a polaron state and the majority of conduction electrons are in these states rather than in the conduction band. The theory uses the usual concept of failure to maintain stable energy exchange between the lattice and the conduction electrons. The theory as developed agrees well with experimental results for several different materials. C.A.Hogarth

537.529

13350. ON SOME PROCESSES IN THE ELECTRIC BREAKDOWN OF SOLID DIELECTRICS. A.A.Vorob'ev and G.A.Vorob'ev.
Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 22, No. 4, 392-6 (1958).
In Russian. English summary: PB 141041T-4, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

The dielectric strength of single crystals of NaCl, KCl, KBr, and KI was measured as a function of duration of the applied voltage pulse. For pulses shorter than 10^{-7} sec an increase in dielectric

ngth due to discharge delay is observed. In experiments in h a discharge delay is observed there is a relatively large ad in values for dielectric breakdown strength. For rather er applied pulses the spread in dielectric strength depends on erfection of the crystals. Dielectric breakdown in solids is to proceed in two stages, (a) development of discharge, ompletion. C.A.Hogarth

537.529

51. ELECTRIC BREAKDOWN AND CONDUCTION IN $BaTiO_3$ LE CRYSTALS. Y.Inuishi and S.Uematsu.
hys. Soc. Japan, Vol. 13, No. 7, 761-2 (July, 1958).
The dependences of d.c. breakdown strength and of conduct- on temperature were investigated. The mean breakdown ngth of 0.3 to 0.5 MV/cm is rather insensitive to the temperature omparison with large temperature dependence of low field ductivity. The dependence of conduction current on field strength ws that at low fields Ohm's law is applicable; at higher fields, ever, current increases abruptly due to breakdown phenomena. Z.Krasucki

537.529

52. STATISTICAL DISCHARGE TIME LAG IN NaCl AND KBr. .Mel'nikov.
eksper. teor. Fiz., Vol. 36, No. 2, 613-14 (Feb., 1959).
Russian.
The author developed a method of obtaining and recording high- sion pulses (up to 27 kV, front length 10^{-9} sec), using an elec- nic oscillograph with pulsed feed. It was found that NaCl and KBr stals irradiated with X-rays had both a smaller breakdown ength (~ 12% less) and a smaller time lag (16.5-18.5% less) than stals which had not been irradiated. The time-lag difference nts to the existence of the statistical discharge time lag in the -irradiated crystals. F.Lachman

537.529 : 537.533 : 621.385.032.213

THE BREAKDOWN OF THIN ALUNDUM-LAYERS. See str. 12352

X-RAYS

537.531

353. A 5kW X-RAY TUBE WITH A CYLINDRICAL ANODE. Rajewsky and K.Heuss.
angew. Phys., Vol. 11, No. 4, 147-9 (April, 1959). In German.
The aluminium anode concentrates the radiation to the central s of the tube where the maximum dose rate is 2000 r/min. The e operates at 60 kV, 100 mA and is suitable for continuous rilization of food and drugs. J.R.Mallard

537.531

354. APPLICATION OF A MONITOR FOR X-RAY SPECTRAL NALYSIS.
A.Blokhin, I.V.Busler, O.P.Kramarov and I.P.Chernyavskaya.
ibory i Tekh. Eksper., 1959, No. 1, 106-11 (Jan.-Feb.).
Russian.
The output of an X-ray generator for X-ray fluorescence work stabilized by monitoring the intensity of the radiation emitted by auxiliary specimen. The integrated intensity is arranged to ntrol the voltage across the X-ray tube filament, thus stabilizing tube output. T.Mulvey

537.531 : 535.34

355. K ABSORPTION EDGE OF IRON IN THE ALPHA AND GMA PHASES OF THE Fe—Cr SYSTEM. V.A.Kazantsev.
kl. Akad. Nauk SSSR, Vol. 124, No. 4, 806-7 (1959). In Russian.
Brief description of accurate measurement of the K absorption ge of the α and σ phase in Fe—Cr system and its correlation with ctron energy levels. T.Mulvey

537.531

356. MANY-PARTICLE COOPERATIVE SCATTERING OF RAYS IN THE TWO-CRYSTAL SPECTROMETER. W.E.Dibble.
ys. Rev. Letters, Vol. 3, No. 3, 131-2 (Aug. 1, 1959).
It is pointed out that the width of the central maximum of a low- gle diffraction pattern will depend on the width of the coherently adiated part of the specimen, and not on the whole size of the ecimen. It is argued that this latter width will decrease (and the idth of the central maximum will increase) with increasing perfection of the collimating crystal and with decreasing target-to-sample distance. A.R.Stokes

537.531 : 535.3

13357. SCATTERING FACTORS FOR SOME OF THE HEAVIER ATOMS. B.H.Worsley.
Canad. J. Phys., Vol. 37, No. 9, 967-9 (Sept., 1959).
A programme for calculating X-ray atomic scattering factors from the radial wave functions was written for the IBM 350 installation at the University of Toronto. It was applied to the results of self-consistent field calculations previously performed at this University on the FERUT computer. Results are given for Ne, V^{++}, Kr, Ag^{+}, and Pb^{+++}. The results for Ne and V^{++} are compared with those calculated by Freeman using Allen's wave-functions for Ne and Hartree's approximate wave-functions for V^{++}.

537.531 : 548.736.1

13358. EXPERIMENTAL DETERMINATION OF ATOMIC SCATTERING FACTORS. R.B.Roof, Jr.
J. appl. Phys., Vol. 30, No. 10, 1599-603 (Oct., 1959).
The factor for Al has been experimentally reexamined. First-order corrections for the effect of temperature, surface roughness, primary extinction, secondary extinction, and anomalous dispersion were applied to experimental absolute intensity measurements made on a powder slab of aluminium. The average deviation between the experimentally determined and the theoretical atomic scattering factor for aluminium is 0.16 electron. The slightly different shape of the experimental curve, as compared to the theoretical curve, is interpreted as evidence for a greater contraction in the 3p shell of aluminium than had been heretofore assumed.

537.531

13359. REMARKS ON A PAPER BY D.M.VASIL'EV "A METHOD OF RESOLVING THE K_α-DOUBLET IN X-RAY LINES". E.G.Nesterenko.
Zh. tekh. Fiz., Vol. 27, No. 9, 2183 (1957). In Russian. English translation in: Soviet Physics — Technical Physics (New York), Vol. 2, No. 9, 2024 (Sept., 1957).
See Zh. tekh. Fiz., Vol. 25, No. 11, 1994-7 (1955). Nesterenko defends his method of determining true inter-doublet distances from incompletely resolved spectra and claims that an expression of the form $B_0/B = f(\delta/B)$, where B_0 is the true width of the line, B the observed width, and δ the doublet separation, is the most suitable for practical use. T.Mulvey

537.531 : 535.33

13360. THE INTERPRETATION OF SOFT X-RAY EMISSION SPECTRA. J.A.Catterall and J.Trotter.
Phil. Mag. (Eighth Ser.), Vol. 3, 1424-31 (Dec., 1958).
An examination of the K satellite emission bands observed in lithium and beryllium has indicated that the presence of the hole which occurs in the core-level during the soft x-ray emission process is unlikely appreciably to affect the intensity distribution of the spectra.

537.531 : 535.343

13361. THE THEORY OF THE FINE STRUCTURE OF THE X-RAY ABSORPTION SPECTRUM [IN SOLIDS].
T.Shiraiwa, T.Ishimura and M.Sawada.
J. Phys. Soc. Japan, Vol. 13, No. 8, 847-59 (Aug., 1958).
The life-time of the state of the electron ejected by the absorption of a photon is considered. The life-time is mainly determined by the inelastic collision cross-section between the ejected electron and the atoms in the crystal. With the assumption that the inelastic cross-section has a magnitude of the order of $1A^2$, Kronig's method for the molecule is applied to the solid in order to obtain the variation of the transition probability. The wave-function of the final state of the transition is obtained as the sum of the plane wave, whose amplitude decreases with increasing distance from the from the absorbing atom, and the waves scattered by the neighbouring atoms. The calculated results for the K-absorption spectra of copper, nickel and iron agree well with experiments.

537.531 : 539.2

ELECTRONIC BAND STRUCTURE OF SOLIDS BY X-RAY SPECTROSCOPY. See Abstr. 12783

ELECTRON EMISSION . ELECTRON BEAMS

537.533

13362. EFFECT OF OXYGEN ON THE WORK FUNCTION OF BARIUM. P.A.Anderson and A.L.Hunt.
Phys. Rev., Vol. 115, No. 3, 550-3 (Aug. 1, 1959).

While a high sensitivity of the work function to gaseous contaminants is generally characteristic of metals which absorb the common gases strongly, barium combines outstanding work function stability with an exceptional affinity for these gases. The paradox is investigated by administering measured quantities of oxygen to vapour-deposited barium surfaces at known rates, with concurrent monitoring of the work function. It is found (1) that when clean barium is exposed suddenly to a massive dose of oxygen, its work function is lowered by 0.32 eV, (2) that the work function of the heavily oxygenated surface remains constant for 5 days and then drifts very slowly toward the clean-metal value, and (3) that when oxygen is administered to a barium surface slowly (2×10^{13} molecules per cm^2 per hour) no change of work function occurs during or after the absorption of a quantity of oxygen equivalent to 100 complete monolayers of the oxide. The results are interpreted as stemming from two processes which compete for control of the surface: the expected surface oxidation and a restorative process involving engulfment of oxygen ions. The mechanism of engulfment is discussed.

537.533

13363. WORK FUNCTION OF GOLD. P.A.Anderson.
Phys. Rev., Vol. 115, No. 3, 553-4 (Aug. 1, 1959).

The work functions of 16 gold surfaces were determined by measurement of their contact differences of potential with respect to barium reference surfaces of known work function. The gold surfaces were prepared by subjecting spectroscopic standard gold to repetitive fusion-solidification outgassing followed by fractional distillation and condensation on tantalum; the barium surfaces by a similar technique which yields surfaces reproducible and constant to 0.01 eV. Measurement was by the Kelvin method with a time interval of 15 sec between deposition and measurement of a fresh surface. The contact difference of potential Au–Ba is found to be 2.31 ± 0.02 V and the work function of gold 4.83 ± 0.02 eV, referred to a barium work function of 2.52 eV.

537.533

13364. CONTRIBUTION TO THE PROBLEM OF EXO-ELECTRON EMISSION FROM METALS. W.Schaafs.
Z. angew. Phys., Vol. 11, No. 6, 220-3 (June, 1959). In German.

The work function and c.p.d of an oxidized metal surface are not monotonic functions of the thickness but exhibit periodic variations. Mechanical damage exposes various layers between which p.d.'s of a few tenths of a volt exist. Field emission can then occur. In the neighbourhood of the minima of the c.p.d. such electrons cannot leave the metal as exo-electrons. A.H.W.Beck

537.533 : 621.385.032.213.13

13365. ON THE MECHANISM OF THE HIGH TEMPERATURE CONDUCTIVITY OF ELECTRON EMITTING OXIDES. A.Paulisch.
Semiconductors and phosphors (see Abstr. 9597 of 1959) pp.386-91. In German.

Discussion of the manner in which the emitted electrons, redistributed over the emitting surface by the electric fields used in the measurement, influence the measured conductivity.

A.H.W.Beck

537.533

13366. CHARACTERISTICS OF UC, ZrC, AND (ZrC) (UC) AS THERMIONIC EMITTERS. R.W.Pidd, G.M.Grover, D.J.Roehling, E.W.Salmi, J.D.Farr, N.H.Krikorian and W.G.Witteman.
J. appl. Phys., Vol. 30, No. 10, 1575-8 (Oct., 1959).

Uranium carbide is found to have the property of high thermionic emission in the observed temperature range of 1400 to 1800°K. The parameters of the Richardson equation which can be used to fit the data are $A = 7.3 \times 10^5$ A cm^{-2} $(deg\ K)^{-2}$ and $\phi = 4.57$ V. While these parameters accurately predict the observed saturated currents, it is doubtful that such anomalous values are of theoretical significance within the framework of the Richardson–Dushman derivation. A solid solution form of uranium carbide and zirconium carbide gives substantially the same thermionic emission as uranium carbide, and for other reasons appears to be the more useful emitter. The carbides require no surface preparation or activation schedule for use as emitters.

537.533

13367. PHOTOELECTRONIC EMISSION FROM THE SURFACE OF SEMICONDUCTOR CATALYSTS. F.Wilessow and A.Terenin.
Naturwissenschaften, Vol. 46, No. 5, 167-8 (1959). In German.

The spectral response for photoelectron emission from ZnO, NiO and Cr_2O_3, with and without adsorbed gases, is measured. Because of the feeble emission a Geiger counter system is used as electron detector. Oxygen treatment of ZnO shifts the response threshold to shorter wavelengths; CO shifts the threshold to longer wavelengths in the case of ZnO and NiO. For the latter, structure appears in the response curve. Alcohol (C_2H_5OH) vapour moves the threshold to longer wavelengths for all three oxides and there is evidence of a definite orientation of the adsorbed molecules.

G.F.J.Garlick

537.533

13368. VARIATION OF THE SECONDARY ELECTRON EMISSION COEFFICIENT WITH INCIDENT ION ENERGY FOR SOME METALS. P.Cousinie, N.Colombie, C.Fert and R.Simon.
C.R. Acad. Sci. (Paris), Vol. 249, No. 3, 387-9 (July 20, 1959). In French.

Secondary emission coefficients γ for a number of metals under bombardment with A^+ and H^+ ions were investigated as a function of ion energy in the range 5-40 keV. For all targets, γ initially increases with increasing ion energy: in a few cases, γ reaches a maximum within the range studied. Although the form of the γ versus energy curve is similar for all metals, the absolute value of γ differs widely from metal to metal. It is suggested that the process of secondary emission with ions in this energy range is similar to that with electrons of energy ≤ 100 eV, the incident ions transmitting an energy of about 20 eV to electron in the target metal.

C.H.B.Mee

537.533

13369. ON THE PROBLEM OF CORRELATION OF COEFFICIENTS OF SECONDARY ELECTRON EMISSION FROM NONMETALS, CAUSED BY BOMBARDMENT WITH IONS AND ELECTRONS. V.M.Lovtsov.
Zh. tekh. Fiz., Vol. 28, No. 11, 2469-72 (1958). In Russian.

Describes briefly an experimental investigation into correlation between the coefficients of secondary electron emission caused by K ions (γ) and by electrons (σ), both of energy $E_p = 930$ eV, from: (a) Al–Mg or Cu–Mg alloys during their activation; (b) film emitters of Mg–MgO type; (c) emitters having a film of KCl on tantalum. Both (a) and (b) were studied during the changes of their physical and chemical state. The measurements of γ and σ were made using the method of double modulation with a c.r.o. (see Abstr. 1923 of 1955). The graphs of σ against γ are linear, hence $\sigma = a\gamma + b$, where a and b are constants depending on the type of emitter and on the type of the bombarding ion. J.M.Zarzycki

537.533

13370. THE COMPTON CURRENT. B.Gross.
Z. Phys., Vol. 155, No. 4, 479-87 (1959).

The secondary electrons produced by penetrating X-rays and gamma rays move preferentially in the forward direction. In an insulator, absorption of the photon beam is therefore accompanied by an electron current. The current can be measured by a suitable receiver that collects the electrons and absorbs the photons. An approximate expression for the Compton current is established. Results of preliminary measurements are given and found to be in satisfactory agreement with the theory.

537.533 : 621.385.1

13371. ADDENDUM REMARKS ON A DIODE CONFIGURATION OF A THERMO-ELECTRON ENGINE.
W.B.Nottingham, G.N.Hatsopoulos and J.Kaye.
J. appl. Phys., Vol. 30, No. 3, 440-1 (March, 1959).

For background see Abstr. 5495B (1958); J. appl. Phys., Vol. 29, No. 7, 1124-5 (July, 1958) and Abstr. 8827 (1958). (1) The results of Hatsopoulos and Kaye agree with the theory of Nottingham. (2) The load conditions for maximal power output are different from those for maximal efficiency. For a numerical example given the respective values are 10.7 and 12.4%. (3) More research is necessary before correct allowance for power radiation from a porous, grey emitter can be made and the ultimate efficiency is thus not yet predictable, but cannot exceed the values calculated by Hatsopoulos and Kaye. A.H.W.Beck

537.533

372. ON THE POSSIBILITY OF THE ANALYSIS OF THE TOTAL ERGY DISTRIBUTION OF ELECTRONS IN A QUASI-SPHERICAL NDENSER. D.A.Ganichev and K.G.Utkin.
. tverdogo Tela, Vol. 1, No. 4, 648-53 (April, 1959). In Russian.
Practical considerations demand that the ideal analysing denser consisting of two concentric spheres be modified (1) by placing the central sphere by a disk; (2) by providing an aperture the outer sphere for the attachment of an electron gun. The ect of this on the accuracy of analysis is checked by means of aphical ray-tracing. The first modification is shown to introduce ors no greater than 1%, while the second modification introduces ors no greater than 5%. A.E.I. Research Laboratory

537.533

373. CYCLIC MOTION OF CHARGED PARTICLES IN AN ECTRIC FIELD. A.A.Kolomenskii and Fan Shou-syan'.
eksper. teor. Fiz., Vol. 36, No. 1, 271-6 (1959). In Russian.
Formulae are derived which describe cyclic motion of charged rticles in an electric guide field. A field of this type can be ated by a system of special lenses (strong or weak focusing). sonance acceleration of the particles and in particular their phase bility (auto-phasing) which is similar to the familiar magnetic o-phasing are considered. The effect of electromagnetic radia- n (including quantum fluctuations) on the motion of the electrons the electric field is examined. A case is also discussed when particle moves part of the way in an electric field and part in a gnetic field.

537.533 : 538.07 : 621.317.44

ELECTRON BEAM MAGNETOMETER. See Abstr. 13415

537.533

374. THE FIELD CHROMATIC ABERRATIONS IN THE LECTRON MICROSCOPE. Yu.V.Vorob'ev and A.A.Vyazigin.
kl. Akad. Nauk SSSR, Vol. 126, No. 6, 1248-9 (June 21, 1959). Russian.
Earlier works have shown that the field chromatic aberrations the magnetic electron microscope can be corrected by adjusting e magnitude and direction of the currents passing through the nses. For a typical electron microscope, however, the magnitude these aberrations does not exceed 10 A. The present work reveals e existence of a much larger chromatic aberration term dependent mechanical misalignment, and this cannot be eliminated by the ggested adjustments. A.E.I. Research Laboratory

537.533

375. CONSTRUCTION OF AN ELECTROSTATIC VELOCITY LTER. APPLICATION TO ELECTRON MICRO-DIFFRACTION. Beaufils.
R. Acad. Sci. (Paris), Vol. 248, No. 22, 3145-7 (June 1, 1959). French.
In this device, which follows the design of Boersch (Abstr. 37 of 1950), electrons are slowed down be means of an electro- atic immersion lens. Electrons which have lost energy are refl- ted by a fine grid maintained at cathode potential. The filtered ectrons are then accelerated and a normal image is formed on e fluorescent screens by means of a second immersion lens. e filter rejects electrons that have suffered a loss of more than V. A.E.I. Research Laboratory

537.533 : 530.145

CALCULATIONS ON THE SCATTERING OF 15.6 MeV LECTRONS BY Au AND Be. See Abstr. 13016

537.533 : 771.531

THE ACTION OF ELECTRONS ON EMULSION PLATES. e Abstr. 12923

ION EMISSION . ION BEAMS

537.534 : 545.827

FIELD-EMISSION ION SOURCE. See Abstr. 13882

537.534

376. A STUDY OF THE MOTION OF A CHARGED PARTICLE IN HE MAGNETIC FIELD OF A TOROIDAL SOLENOID. Sacerdoti.
Atti Accad. Sci. Torino 1, Vol. 93, No. 1, 72-83 (1958-9). In Italian.
Gives detailed calculations of the motion in a plane perpendicular to the lines of force, with formulae for the orbit shape, the period of rotation and for the mean velocity in the direction perpendicular to the field gradient. The formulae are expansions in powers of the ratio of the Larmor radius to the major radius of the torus. R.S.Pease

537.534

13377. A STUDY OF A FIGURE-OF-EIGHT MAGNETIC CONTAINER. G.Sacerdoti.
Atti Accad. Sci. Torino 1, Vol. 93, No. 1, 62-71 (1958-9). In Italian.
Calculates the particle drifts in a plane normal to the magnetic field; these are of opposite sign in different halves of the container, and the containment times are much longer than for a simple toroidal field. Details of the oscillation motion are discussed. R.S.Pease

537.534

13378. VELOCITY MODULATION TYPE MASS SPECTROSCOPE. H.Ezoe and T.Hayashi.
Sci. Pap. Inst. Phys. Chem. Res. (Tokyo), Vol. 53, 1-8 (March, 1959).
Analyses a time-of-flight non-magnetic mass spectroscope, in which the ions are velocity-modulated by a saw-tooth superimposed on a d.c. voltage. In the drift space this produces — by bunching — a spatial mass spectrum periodically, so that in principle a periodic pulsed transverse electric field taking the ions on to a photographic plate may be used. The factors affecting resolution are discussed. B.Meltzer

537.534

13379. A THREE FILAMENT ASSEMBLY FOR A SOLID SOURCE MASS SPECTROMETER WITH ALTERNATELY HEATED SIDE FILAMENTS. J.Schutten.
Z. Naturforsch., Vol. 14a, No. 8, 764-5 (Aug., 1959).

537.534

13380. ENERGY–RANGE RELATION OF 660 MeV PROTONS. V.P.Zrelov and G.D.Stoletov.
Zh. eksper. teor. Fiz., Vol. 36, No. 3, 658-68 (1959). In Russian.
The mean range of protons in copper was determined by the method of slowing down protons in copper. The proton energy was computed from the measured angle of emission of Vavilov-Cherenkov radiation by protons in plexiglas. With relevant corrections, the range of (658 ± 2) MeV protons in copper was found to be (257.6 ± 1.2) g/cm^2. Assuming the ionization potential to be independent of the velocity, the calculated value of I_{Cu} is found to be (305 ± 10) eV. The stopping power with respect to copper was also measured for H, Be, C, Fe, Cd, W.

PARTICLE ACCELERATORS

537.54

13381. THE PRESENT STATE OF THE PROBLEM OF ACCELERATION OF ATOMIC PARTICLES. V.I.Veksler.
Uspekhi fiz. Nauk, Vol. 66, No. 1, 99-110 (Sept., 1958). In Russian. English translation in: Soviet Physics – Uspekhi (New York), Vol. 66(1), No. 1, 54-61 (Sept.-Oct., 1958).
Review article of the present position in particle acceleration. Methods for obtaining higher energies are discussed briefly, in particular the use of a plasma waveguide, coherent acceleration and the relativistically stabilized beam. J.W.Sturgess

537.54 : 539.17

CAPSULE-TYPE CYCLOTRON TARGET. See Abstr. 13654

537.54

13382. 16" VARIABLE ENERGY CYCLOTRON. H.Kumagai, K.Ôno, H.Shôno, I.Hayashi, K.Kuroda and M.Imaizumi.
J. Phys. Soc. Japan, Vol. 14, No. 1, 1-9 (Jan., 1959).
This was constructed to produce 1-2 MeV deuterons and 2-4 MeV α-particles. Improved magnet and oscillator systems are incorporated. It was found possible, by adjustment of the acceleration parameters of the cyclotron, to produce deuterons and α-particles over a sufficiently wide range of energy within 1 min. The cyclotron can be used for producing 2-4 MeV protons by changing a part of the resonator.

IONIZATION . PLASMA

537.54 : 539.1

13383. THE STATE OF CONSTRUCTION OF THE ITALIAN 1200 MeV ELECTRON SYNCHROTRON AND THE RESEARCH PROGRAMME. M.Ageno, A.Alberigi, F.Amman, C.Bernardini, U.Bizzarri, G.Bologna, G.Corazza, G.Cortellessa, G.Diambrini, G.Ghigo, A.Massarotti, G.C.Moneti, G.Murtas, E.Persico, M.Pugliesi, I.F.Quercia, R.Querzoli, G.Sacerdote, G.Salvini, G.Sanna, R.Toschi and A.Turrin.
Nuovo Cimento Suppl., Vol. 11, No. 3, 324-44 (1959). In Italian.

The construction of the machine is nearly completed and most of the parts have been extensively tested. The magnet has operated for 500 hours at a field of 9260 G (corresponding to 1000 MeV) and tested up to 11 200 G (1200 MeV) and the field correction coils and circuits have been installed. The doughnut is about 27 m long and 270 × 78 mm in cross-section with 10 mm walls. It is lined internally with stainless steel suitably sub-divided to reduce induced currents. The four quadrants are joined by four straight portions; which house the injector, first r.f. section, second r.f. accelerator and target assembly respectively. The latter is fitted with gate valves so that the target can be changed without admitting air to the doughnut. There are four diffusion pumps each of 3000 l./sec and a pressure in the doughnut of 4×10^{-6} mm has been obtained. The trajectory of electrons can be observed using fluorescent flags of ZnS coated copper gauze with a transmission of 90%, by collecting the beam in a Faraday can, and by the use of induction electrodes (these are cylinders surrounding the beam in which a voltage pulse is induced by the passage of a bunch of electrons). Before the arrival of the 3 MeV Van de Graaff injector tests were made with a Cockcroft–Walton injector giving 1 MeV 5 μsec pulses (the minimum injection energy for which the machine is designed is 2 MeV). At the deflector plates this beam was 2 × 2 mm in cross-section and by 5 μa. After adjustment it was observed to enter the synchrotron and circle the doughnut. A pulsed electrostatic deflector at the outlet of the injector allowed very short pulses of electrons to be injected. After the adjustment of the field correction cores it was possible to observe two circuits of the doughnut. An r.f. accelerating voltage of 60 kV has been produced and this is sufficient to accelerate electrons to 1000 MeV. The frequency can be measured to 0.1% nd the field with an accuracy of 30 G in 10 000 G. The experimental programme is a little behind the construction of the accelerator itself. An ionization chamber has been built for measurement of the total energy of the beam. As an independent check a special mercury calorimeter is being developed which, by measuring the expansion of mercury, will measure temperature rises of the order of 0.001°C. Other instruments being developed include a pair spectrometer, magnetic analysers, a cloud chamber and a helium-cooled liquid hydrogen target. Experiments planned include the measurement of the differential cross-section for the reaction $\gamma + p \rightarrow n + \pi^+$, photoproduction of mesons in a cloud chamber for studying the reactions $\gamma + n \rightarrow \pi^- + p$, and $\gamma + p \rightarrow \pi^+ + \pi^- + p$. The cross-sections for pair production and bremsstrahlung in single crystals will be compared with those for amorphous materials and with theoretical predictions.
R.D.Smith

537.54

13384. INTERSECTING-BEAM SYSTEMS WITH STORAGE RINGS. G.K.O'Neill and E.J.Woods.
Phys. Rev., Vol. 115, No. 3, 659-68 (Aug. 1, 1959).

The equivalence of fixed- and variable-field particle acceleration systems for the adiabatic damping of synchrotron oscillations is pointed out. These two quite different acceleration methods are therefore able to produce particle beams of equal density for beam stacking purposes. The transfer mechanism between an accelerator and storage ring is discussed, and the properties of a fast-rise 3-kilogauss beam-switching magnet are shown. It is concluded that the source interaction rate obtainable in a proton storage ring system would be nearly independent of the focusing properties and repetition rate of the injecting accelerator. An improved design for intersecting-beam storage rings is described, in which several well-separated interaction regions could be used for simultaneous experiments. Standard types of alternating-gradient magnets would be required, and the overall weight of synchrotron plus storage rings would be about one-tenth as large as that of comparable beam-stacking accelerators.

537.56

13385. THE PRINCIPLE OF MINIMUM ELECTRODE VOLTAGE AND EXTREME ENTROPY PRODUCTION. M.Steenbeck.
Naturwissenschaften, Vol. 46, No. 11, 373 (1959). In German.

A brief note outlining certain basic considerations relating to the thermodynamics of "the minimum discharge voltage" principle.
J.D.Craggs

537.56

13386. ELECTRIC FIELD DISTRIBUTIONS IN AN IONIZED GAS. M.Baranger and B.Mozer.
Phys. Rev., Vol. 115, No. 3, 521-5 (Aug. 1, 1959).

A method for improving systematically the Holtsmark distribution (Abstr. 753 of 1919) is described. It is based on a cluster-type expansion and takes into account increasing orders of correlation. In this paper, it is applied to the calculation of the distribution of the high-frequency component of the electric field in an ionized gas in thermal equilibrium.

537.56

13387. THE THEORY OF THE RELAXATION EFFECTS IN ELECTRON AVALANCHES. K.J.Schmidt-Tiedemann.
Naturwissenschaften, Vol. 46, No. 6, 199 (1959). In German.

The electron density at the head of the avalanche is worked out allowing for the thermal relaxation of the electrons, but simplifying assumptions are made about the gas amplification process. The form of the avalanche head is obtained together with its mean velocity.
A.E.I. Research Laboratory

537.56

13388. A POSSIBLE MECHANISM OF THE POTENTIAL VARIATION OF THE JOSHI EFFECT. M.Venugopalan.
J. Phys. Soc. Japan, Vol. 13, No. 12, 1544-6 (Dec., 1958).

The mechanism of the variation ± Δi of the discharge current with applied potential is discussed in relation to the interaction of external radiation with an adsorbed phase on an excited surface, the formation, stability and destruction, by electron detachment, of negative ions.
G.C.Williams

537.56

13389. CALCULATION OF THE IONIZATION OF AIR AROUND BETA AND ALPHA SOURCES. Ya.Chudars and I.Taure.
Latv. PSR Zinat. Akad. Vestis, No. 3 (140), 33-44 (1959). In Russian

Having developed expressions for the variation of kinetic energy of electrons in the substance layers, the multiple scattering being taken into account, the authors develop the methods of calculating the spatial ionization round the point, filiform, and flat sources of (1) monoenergetic electron beams, (2) beta rays and (3) alpha rays.
F.Lachman

537.56

13390. SECONDARY IONIZATION IN HUMID AIR. J.M.Meek.
Nature (London), Vol. 183, 1805-6 (June 27, 1959).

A brief discussion of certain measurements, principally of Townsend's secondary ionization coefficient γ, in air containing controlled amounts of water vapour. It is suggested that the low γ's found in these conditions are due to absorption of u.v. photons, in the water vapour, before they reach the cathode.
J.D.Craggs

537.56

13391. SPECIFIC TOTAL IONIZATION AND IONIZATION LOSS FOR 15 MeV ELECTRONS IN AIR AND VARIOUS GASES. B.Markus.
Naturwissenschaften, Vol. 46, No. 12, 397-8 (1959). In German.

Briefly discusses the experimental method and apparatus, and gives data for air, H_2, N_2, A and CH_4.
J.D.Craggs

537.56

13392. ENERGY SPECTRUM OF ELECTRONS EMITTED FROM GASES BOMBARDED BY POSITIVE IONS. D.E.Moe and O.H.Petsch
Phys. Rev., Vol. 115, No. 2, 349-50 (July 15, 1959).

The energy spectrum of electrons emitted during ionization of gases bombarded with positive ions was studies for electrons emitted parallel and perpendicular to the incident ion beam. The observed spectra are not strongly dependent upon the direction of electron emission.

537.56

13393. THE PROPAGATION OF HIGH-FREQUENCY CURRENTS IN IONIZED GAS [DISCHARGE] TUBES. T.V.Ionescu.
Rev. de Physique (Bucarest), Vol. 3, No. 2, 89-106 (1958). In French.
The effective inductance L and capacitance C of a tube containing ionized gas are given in terms of geometrical constants, the electron density etc. Thus a "velocity of propagation" $(LC)^{-1/2}$, where L and C refer to unit tube length, can be derived. Experiments with various tube geometries, e.g. multi-section divided tubes, are described. J.D.Craggs

537.56

13394. PLASMA PHYSICS AND THE PROBLEM OF CONTROLLED THERMONUCLEAR REACTIONS. [FOUR VOLUMES]. VOLUME III.
London: Pergamon Press (1959) 422 pp.
Contains English translations of a selection of articles on the theoretical and experimental investigations carried out at the Institute of Atomic Energy of the U.S.S.R. Academy of Sciences between 1951 and 1958. Abstracts of the individual articles will be published in later issues of "Science Abstracts".

537.56 : 538.566.2

13395. PROPAGATION OF ELECTROMAGNETIC WAVES IN COMPLETELY IONIZED RESISTIVE PLASMAS. J.M.Dolique.
Ann. Radioelect., Vol. 14, 107-41 (April, 1959). In French.
Some generalities are presented on completely ionized plasmas and on their various mathematical descriptions. The fundamental fluid-plasma equations are given, based on the transport equation. These equations are applied to the study of the principal types of electromagnetic wave ($\lambda > 1$ mm) capable of being propagated in a completely ionized plasma (hydromagnetic waves are also examined). The article is not restricted to the classical case of infinite conductivity: the various propagation constants for finite conductivity are obtained. Graphical representations are used in the frequency—resistivity plane: for each type of wave they constitute the frontier between domains corresponding to propagation at practically constant amplitude, and those corresponding to an attenuation.

537.56

13396. THE INFLUENCE OF A LONGITUDINAL MAGNETIC FIELD ON THE LINEAR PINCH EFFECT.
W.Herold, E.Fünfer, G.Lehner, H.Tuczek and C.Andelfinger.
Z. Naturforsch., Vol. 14a, No. 4, 323-9 (April, 1959). In German.
Gives a detailed account of experimental results obtained in a study of high-current (~ 300 kA) pinched discharges in deuterium at pressures between 10^{-2} and 10^{-1} mm Hg under rates of rise of current of 6 x 10" A/sec in the presence of an axial magnetic field up to 1.1 kG. C.G.Morgan

537.56

13397. CONFINEMENT OF PLASMA BY STANDING ELECTROMAGNETIC WAVE. V.Cushing and M.S.Sodha.
Phys. of Fluids, Vol. 2, No. 5, 494-8 (Sept.-Oct., 1959).
In this paper the authors discuss the confinement of plasma by a one-dimensional stationary electromagnetic wave. Their analysis is similar to that carried out by former workers for a TM_{01} mode but they have examined the assumptions limiting the applicability of present theories in detail. One of the conditions for the applicability of the present theory is that the frequency of the electromagnetic wave should be of the same order or greater than the plasma frequency at the nodes where particle density is maximum. This condition makes the present theories nonapplicable in cases of thermonuclear interest.

537.56

13398. STUDY OF THE FORMATION OF TRAVELLING LAYERS BY PERTURBATION METHODS. A.A.Zaitsev and M.Ya.Vasil'eva.
Dokl. Akad. Nauk SSSR, Vol. 127, No. 1, 63-6 (July 1, 1959). In Russian.
Layer formation in inert gases is studied by applying square voltage pulses (of 1 μsec width at 50 c/s) to a point electrode in the tube. The decay of layer oscillations was found to depend on the deviation of current from its critical value. Several oscillograms are shown and wave shapes discussed. Layer velocities were measured and are tabulated. The difference between the travelling waves and the so-called electrostatic waves in the plasma is stressed. J.K.Skwirzynski

537.56

13399. CYCLOTRON RESONANCE IN GAS DISCHARGE.
K.Fukuda, H.Matumoto, Y.Uchida and H.Yoshimura.
J. Phys. Soc. Japan, Vol. 14, No. 4, 543 (April, 1959).
Measurements were made using microwave cavity technique at a frequency of 24 000 Mc/s. The electron density was ~ 10^{10} per cm^3. Measurements of electron collision frequencies (magnetic field perpendicular to the cavity axis) were in general agreement with theory. J.D.Craggs

537.56

13400. ELECTRON AND ION RUNAWAY IN A FULLY IONIZED GAS. I. H.Dreicer.
Phys. Rev., Vol. 115, No. 2, 238-49 (July 15, 1959).
Hydrodynamic equations are used to describe the flow of the electrons and ions of a fully ionized gas under the action of an electric field, E, of arbitrary magnitude. The dynamical friction force exerted by the electrons and ions upon each other through the agency of two-body Coulomb encounters is evaluated. In this connection the electrons and ions have been assigned Maxwellian velocity distributions which are displaced from each other by their relative drift velocity. This treatment yields a dynamical friction force which maximizes when the relative drift velocity is equal to the sum of the most probable random electron and ion speeds. For relative drift velocities in excess of this value the friction force decreases rapidly. As a consequence, it is found that a fully ionized gas cannot exhibit the steady-state behaviour characterized by time independent drift velocities which has previously been accredited to it by other authors. Instead, it is shown that the electron and ion currents flowing parallel to the existing magnetic field increase steadily in time (i.e., runaway) as long as a component of the electric field persists along the magnetic field. Drift velocities which greatly exceed the random speeds of the plasma particles can be created in this manner. The theory yields a critical electric field parameter, E_C, which is proportional to the plasma density and inversely proportional to its temperature. It is a measure of the electric field which is required if the drift velocities are to increase and exceed the most probable random speeds in the gas in one mean free collision time. For electric fields in excess of E_C runaway proceeds even faster. In smaller fields runaway occurs when Joule heating has depressed E_C sufficiently. Several interpretations of E_C are given in terms of the collisional phenomenon involved. Within the framework of the hydrodynamic equations it is shown that the well-known $(\text{temperature})^{3/2}$ electrical conductivity law can be recovered, provided $E \ll E_C$ and the electron temperature is held constant. Numerical solutions giving electron temperature and drift velocity as a function of time are presented for a range of the ratio E/E_C. The assumption of the displaced Maxwellian distribution is justified on the basis of a comparison between the rate of Joule heating and the rate of equipartition of random speeds. Moreover, it is found that the use of an anisotropic velocity distribution does not affect the runaway phenomenon in any important way. The possibility of runaway induced across magnetic fields by steep pressure gradients and its relation to diffusion across magnetic fields is examined and discussed in detail.

537.56

13401. DISSIPATION OF CURRENTS IN IONIZED MEDIA.
O.Buneman.
Phys. Rev., Vol. 115, No. 3, 503-17 (Aug. 1, 1959).
For previous work, see Abstr. 5993 (1958). The destruction of electron drifts by instabilities is analysed. The fastest stable drift is calculated (drift energy 0.9 kT) and the energy of a faster drift is found to be dissipated into instabilities, within, typically, 30 plasma periods. The growth of a local disturbance in this process is shown to take place without effective propagation. The "turbulent" flow pattern created, eventually, under nonlinear conditions is calculated numerically, demonstrating the tendency towards randomization of the initial drift energy. The effect stops "runaway" in about 100 plasma periods after which there is "heating" by "collective collisions" instead.

537.56

13402. FIELD MIXING AND ASSOCIATED NEUTRON PRODUCTION IN A PLASMA. A.C.Kolb, C.B.Dobbie and H.R.Griem.
Phys. Rev. Letters, Vol. 3, No. 1, 5-7 (July 1, 1959).
Magnetic field strengths were measured in the plasma created by discharging a 15 kV, 130-400 μF capacitor into a single-turn coil surrounding a 5 cm i.d. pyrex tube containing deuterium. The deuterium is preheated by a separate 20 kV, 1μF discharge. The

field from the preheat is trapped in the plasma and compressed by the main discharge. Nuclear reactions were observed only when this trapped field is of opposite sign to the main field. Such reactions could arise from deuterons accelerated in the strong electric fields produced by field mixing in the region between the two magnetic fields. R.S.Pease

537.56

13403. PRODUCTION OF TWO TEMPERATURES IN AN IONIZED GAS IN A MAGNETIC FIELD. E.Larish and I.Shekhtman.
Zh. eksper. Teor. Fiz., Vol. 35, No. 2(8), 514-15 (Aug., 1958).
In Russian. English translation in: Soviet Physics—JETP (New York) Vol. 35(8), No. 2, 355 (Feb., 1959).

Calculates the ratio of electron and ion temperatures for the case: ions assumed maintained at constant temperature; electrons lose energy by cyclotron radiation. Assumes ordinary ion–electron Coulomb collisions, and no self-absorption of cyclotron radiation. R.S.Pease

537.56 : 539.17

ION CHAMBER CAN DETECT NUCLEATE BOILING. See Abstr. 12710

COSMIC RAYS

537.591 : 778.34

13404. EMULSION CONTAINERS FOR COSMIC RAY RESEARCH IN HIGH-ALTITUDE ROCKETS. H.Yagoda.
"Particle photography" conference, Strasbourg 1957 (see Abstr. 11704 of 1959) pp. 423-32. In French.

An attempt to expose nuclear emulsions to the cosmic radiation above the atmosphere by means of high-altitude rockets is outlined. A description is given of the construction of protective containers with a vertical mass absorption of 270 mg/cm^2, which have proved capable of withstanding the terminal impact velocities of a little less than 300 mile/hr. The nose-cone of the rocket is ejected above the atmosphere and the section containing the instruments is detached on a parachute. Consequently the exposure to cosmic radiation and to micrometeorites takes place with the minimum of $\leq$ 200 mg/cm^2 of surrounding absorbing material at all angles. In 22 attempts at an exposure, covering a period of 8 years, the instrument part of the rocket was recovered 14 times. In 8 flights the emulsions were recovered in good condition after reaching maximum altitudes of 127 to 255 km. S.J.St-Lorant

537.591

13405. AN ATTEMPT TO MEASURE THE TOTAL RADIATION AT HIGH ALTITUDE. J.Labeyrie and H.Le Boiteux.
J. Phys. Radium, Vol. 20, No. 5, 574-5 (May, 1959). In French.

Three Geiger counters were mounted in the head of an experimental missile with their axes parallel to that of the missile. The counters were 10 mm wide and had an effective length of 38 mm. They were filled with neon-argon-bromine mixture. Their wall thickness was 300 mg cm^{-2} of glass, 30 mg cm^{-2} of steel and they were protected by 300 mg cm^{-2} of aluminium. Connected in parallel they gave a sea level counting rate of 0.5 pulses per second. The ascent of the missile took place at 43°N; during its flight the pulses were telemetered to ground and their frequency determined for three second intervals. The flight achieved a height of 65 km. The maximum cosmic-ray intensity of about 53 times the sea level value was observed at 18 km. The plateau value reached above 45 km was 37% of the maximum intensity. E.G.Michaelis

537.591.15

13406. A CLOUD-CHAMBER STUDY OF PENETRATING SHOWERS PRODUCED BY COSMIC RAYS IN LITHIUM.
M.Gribi, F.Heinrich, H.Loeliger, J.M.Pictet, A.Rytz, H.Wäffler and M.Walter.
Helv. phys. Acta, Vol. 32, No. 3, 213-48 (1959). In French.

Showers produced by charged cosmic ray particles in a lithium target were examined in a cloud chamber at an altitude of 11350 ft a.s.l. The chamber contained three gold plates. Details are given of its construction and of the methods of photography and reprojection of the observed events. Results of the analysis of 197 showers produced in the lithium targets are presented. The observed multiplicity distribution is corrected for the effect of the selection system. A number of events showing V^0 decays is described. The fraction of lithium showers showing V^0 decays is found to be 1.2 ± 0.7%; for an aluminium target the corresponding value is 8%. The energy E_{π^0} of the π^0 component is found from a study of the cascades produced by the decay gamma rays. The mean energy of the neutral pions is determined as 2.2 GeV, while the mean energy per shower in form of neutral pions is 2.7 GeV. The observed multiplicities of charged particles are compared to theories of meson production The variation of E_{π^0} with multiplicity is compatible with the results of Terreaux (Abstr. 3677 of 1952), based on the theory of plural production due to Heitler and Janossy; no evidence is found in favour of Heisenberg's theory of multiple production. It is suggested that a decisive test could be performed by using a liquid hydrogen target above the chamber. E.G.Michaelis

537.591.15 : 523.75

13407. PROTONS FROM THE SUN ON MAY 12, 1959.
E.P.Ney, J.R.Winckler, and P.S.Freier.
Phys. Rev. Letters, Vol. 3, No. 4, 183-5 (Aug. 15, 1959).

The sequence of events following a class 3+ flare on 10 May, 1959 is described, with particular reference to the most spectacular increase in cosmic rays so far observed in balloon flights on 12 May. It is believed that the nucleons were definitely associated with the flare, and were not released from the Van Allen belt. G.M.Brown

537.591.2

13408. ENERGY SPECTRUM OF THE HEAVY NUCLEI IN THE COSMIC RADIATION BETWEEN 7- AND 100-BeV/NUCLEON.
P.L.Jain, E.Lohrmann and M.W.Teucher.
Phys. Rev., Vol. 115, No. 3, 654-9 (Aug. 1, 1959).

See also Abstr. 13670 (1959). The energy spectrum of the heavy nuclei of the cosmic radiation was determined between 7 BeV/nucleon and 100 BeV/nucleon. The distribution for the M($6 \leq Z \leq 9$) and H($Z \geq 10$) charge groups agree with one another within the limits of error. Combining both charge groups, the integral spectrum is of the form $N(>E) \sim E^{-1.6 \pm 0.1}$ (E = total energy/nucleon). Flux values for nuclei of the M, H, and VH ($Z \geq 20$) charge groups at the geomagnetic equator are given. Comparing these results with flux values obtained at high latitudes, it is concluded that a power spectrum of the form $E^{-1.6}$ fits all three charge groups within the limits of error between 2.5 BeV/nucleon and 7 BeV/nucleon. From the observation of α-particle showers of very high energy it is concluded that under certain assumptions the integral spectrum of α-particles can be represented by $N(>E) \sim E^n$ with $n = -1.58_{-0.18}{}^{+0.21}$ for energies $\leq$ 1500 BeV/nucleon

537.591.2 : 551.594.51

VELOCITY DISPERSION OF AURORAL PROTONS.
See Abstr. 12515

537.591.5

13409. A DECREASE IN THE INTENSITY OF THE COSMIC RADIATION OBSERVED UNDERGROUND, AT SEA LEVEL AND AT MOUNTAIN ALTITUDE.
P.Chaloupka, P.Mokrý, T.Kowalski, T.Sándor, A.Somogy and F.Telbisz.
Nuovo Cimento, Vol. 12, No. 6, 639-41 (June 16, 1959).

Standard I.G.Y. neutron monitors and μ-meson telescopes situated at Prague (228 m a.s.l.) and on the Lomnicky Peak (2634 m a.s.l.) registered a decrease in the cosmic-ray intensity on March 25th 1958, at 17 hr 46 ± 6 min U.T. A decrease of 6.5 ± 0.6 ‰ was simultaneously observed with a μ-meson telescope situated 18 m below ground at Budapest (410 m a.s.l.). Following upon the intensity decrease abnormally large daily variations were found at these stations for several days. E.G.Michaelis

537.591.5

13410. THEORETICAL STUDY OF THE COSMIC RAY EQUATOR.
P.J.Kellogg and M.Schwartz.
Nuovo Cimento, Vol. 13, No. 4, 761-8 (Aug. 16, 1959).

Calculations of cut-off rigidities for cosmic-ray particles in the earth's magnetic field have been carried out, using an approximation to the earth's field which includes all moments up to and including the octupole moments. The results show that deviations of the cosmic-ray intensity from that calculated on the dipole approximation may be ascribed to the higher moments of the earth's field.

537.591.5 : 550.384

13411. THE RELATION BETWEEN COSMIC-RAY INTENSITY AND GEOMAGNETIC ACTIVITY DURING PERIODS OF HIGH AND LOW SOLAR ACTIVITY. R.Van Der Walt.

o Cimento, Vol. 13, No. 5, 936-43 (Sept. 1, 1959).
The phase relationships between variations in cosmic-ray sity and geomagnetic activity were studied for the period June, to August, 1958. The results indicate a definite difference in elationship for periods of high and low solar activity. It is ested that this difference may be due to the more frequent rence of severe Forbush decreases during periods of maximum activity.

537.591.8

2. THEORY OF MULTIPLE PARTICLE PRODUCTION AT REMELY HIGH ENERGY. Z.Koba and S.Takagi.
schr. Phys., Vol. 7, No. 1, 1-47 (1959).
This review article is concerned with processes initiated by very energy ($> 10^3$ GeV) particles in cosmic rays. It begins with a summary of the experiments on extensive air showers and by sion techniques up to mid-1958. Heisenberg's non-linear theo- the bremsstrahlung theory, the statistical theories of Landau Fermi, and the isobar model are outlined. It is suggested that theory may have a region of applicability in explaining these plex phenomena. More progress may be made in a phenomenol- al approach of fitting "classifying variables" to the experimental for example, the "collision time" [Z.Koba, Utyûsen-Kenkyû, 3, 179 (1958)] suggested by one of the authors.

D.W.L.Sprung

537.591.8

3. NUCLEAR INTERACTION OF HEAVY PRIMARY COSMIC IATION. P.L.Jain.
vo Cimento, Vol. 13, No. 4, 839-48 (Aug. 16, 1959).
In a stack of 30 nuclear emulsions exposed to cosmic radiation the geomagnetic equator, 65 tracks of heavy primary nuclei e located. Out of the total 65 tracks of heavy nuclei, 24 exhibited ractions with the nucleons of the emulsion. In 10 of these 24 ractions primary particles break up into fragments of charge –2. charge of these particles is determined by δ-ray counting and n gap length distribution,while the energy per nucleon is found n the relative scattering method and from the opening angle of fragments.

MAGNETISM

MAGNETIC RESONANCES

538.07

14. ELECTRONIC APPARATUS FOR THE MEASUREMENT OF GNETIC SUSCEPTIBILITIES AT LOW TEMPERATURES.
oussot-Dubien.
. Acad. Sci. (Paris), Vol. 248, No. 22, 3165-6 (June 1, 1959).
rench.
Describes the modifications made to previously described aratus (Abstr. 2561 of 1954 and 3839 of 1956), for the room- perature measurement of magnetic susceptibilities at high quencies, to enable measurements to be made over the perature range from 78° to 300°K. The precautions necessary to ure satisfactory operation are discussed. S.A.Ahern

538.07 : 537.533 : 621.317.44

15. ELECTRON BEAM MAGNETOMETER.
arton, L.B.Leder, J.W.Coleman and D.C.Schubert.
tes. Nat. Bur. Stand., Vol. 63C, No. 1, 69-75 (July-Sept., 1959).
A theoretical investigation of the electron optics of an electron m deflection method for detecting small magnetic fields is pre- ted. It is shown that remarkably high sensitivity can be reached. aboratory model of such a magnetometer was constructed, and it demonstrated that the theoretical estimate of sensitivity, 10^{-5} A/Oe, could be attained in practice. A discussion of the sible improvements which could extend the sensitivity of the ice is also given.

538.2 : 539.19

MAGNETIC PROPERTIES OF THE HYDROGEN MOLECULE.
Abstr. 13757

538.2

16. THE PRESSURE DEPENDENCE OF THE BASIC RAMETERS OF THE DE HAAS—VAN ALPHEN EFFECT IN IC. B.I.Verkin and I.M.Dmitrenko.
kl. Akad. Nauk SSSR, Vol. 124, No. 3, 557-8 (1959). In Russian.
The authors measured the period and amplitude of the de Haas—van Alphen effect in zinc by the torque method under hydrostatic pressures of up to 1750 kg/cm², in fields of up to 20 000 G, and at temperatures of 4.2, 14 and 20°K. Both the period and amplitude of the de Haas—van Alphen oscillations were found to have a complex periodic dependence on pressure. For free crystals the periods were independent of temperature below 25°K, but a considerable increase with temperature was observed for crystals under pressure. These results are not explained by the present theory of the de Haas—van Alphen effect. M.G.Priestley

538.2

13417. PROPERTIES AND STATE OF METAL ATOMS IN CERTAIN ORGANO-METAL COMPOUNDS. Ya.G.Dorfman.
Dokl. Akad. Nauk SSSR, Vol. 125, No. 4, 765-6 (April 1, 1959).
In Russian.
When diamagnetic susceptibilities of the metallic elements are computed from measurements of magnetic properties of organo-metal compounds, allowance must be made for the para- magnetic component of the whole molecule. Computed on this basis diamagnetic susceptibilities of Hg, Ge, Sn and Pb are in a good agreement with theoretical values. J.Adam

538.2

13418. THE POLARIZATION E.M.F. OF VERY THIN DIAMAGNETIC FILMS. A.Munteanu and A.Cişman.
Rev. de Physique (Bucarest), Vol. 3, No. 1, 5-15 (1958). In French.
Describes the apparatus used and the results obtained in an investigation of the polarization e.m.f. of thin electrodeposited films of copper and silver. A.E.De Barr

538.2

13419. MAGNETIC INVESTIGATIONS ON COPPER–IRON ALLOYS.
E.Scheil, E.Wachtel and A.Kalkuhl.
Ann. Phys. (Leipzig), Folge 7, Vol. 4, No. 1-5, 58-65 (1959).
In German.
It is found from magnetic susceptibility measurements that iron is precipitated in the paramagnetic γ-phase from supersatura- ted iron–copper mixed crystals. Part of this iron can be converted into the ferromagnetic α-phase by plastic deformation. Complex susceptibility changes on annealing are interpreted in terms of changes in the homogeneous phase. These changes are not specified further. The evaluation of Bohr magneton number leads to the conclusion that iron ions in the mixed crystal are doubly charged. R.Parker

538.2

13420. DEPENDENCE OF MAGNETIC SUSCEPTIBILITY OF SALTS ON THEIR WATER CONTENT. G.I.Kruglyakova.
Dokl. Akad. Nauk SSSR, Vol. 123, No. 3, 443-5 (1958). In Russian.
One of the widest used instruments in the USSR for the deter- mination of the magnetic susceptibilities of mineral ores is the Dolginor astatic magnetometer. The calibration of such an instru- ment by "standard" salts reveals how considerable is the effect of the water content of salts upon their susceptibility. Curves are given for $NiSo_4$ and $CoCl_2$ of χ versus % water. Straight line graphs are obtained, elbowed in the second case, continuous from 100% salt to 100% water. It is suggested that the very high regularity of the graphs makes the method of susceptibility measurement peculiarly suitable for determination of the % hydration of mineral salts and concentration of solutions. C.R.S.Manders

538.2

13421. MAGNETIC SUSCEPTIBILITY OF CLOSE-PACKED HEXAGONAL GOLD–INDIUM ALLOYS.
T.B.Massalski, L.Meyer and D.Weiner.
Phys. Rev., Vol. 115, No. 2, 301-2 (July 15, 1959).
Measurements were made at 300°, 77°, 4.2°, and 1.2°K. The susceptibility data show a striking similarity to the c-axis spacing, exhibiting a maximum at about 19 atomic % In, consistent with a model assuming that the Fermi surfaces touch the Brillouin zone face (0002) at this concentration.

538.2

13422. PARAMAGNETIC RELAXATION IN NICKEL FLUOSILICATE.
K.D.Bowers and W.B.Mims.
Phys. Rev., Vol. 115, No. 2, 285-95 (July 15, 1959).
Physical models of the paramagnetic relaxation process are briefly reviewed, and a description is given of the pulsed microwave method of investigation. This method was applied to the study at low temperatures of zinc/nickel fluosilicate at various magnetic

dilutions, and an additional relaxation process was observed which is associated with the sharing of energy among the spins. The results depend only on the temperature and magnetic concentration, and are independent of all other experimental conditions provided that excessive power levels are avoided. The lack of size dependence indicates that the relaxation rate is not controlled by spatial diffusion of phonons. The temperature dependence which has been observed is too acute to fit the 1/T law of the simple "direct process" model, and suggests that the relaxation rate is controlled either by phonon combination probabilities or by a Raman type of interaction between phonons and spins.

538.2

13423. ON THE CURIE POINTS AND HIGH TEMPERATURE SUSCEPTIBILITIES OF HEISENBERG MODEL FERROMAGNETICS. G.S.Rushbrooke and P.J.Wood.
Molecular Phys., Vol. 1, No. 3, 257-83 (July, 1958).

The first six coefficients in the expansion of the susceptibility χ, and its inverse χ^{-1}, in ascending powers of the reciprocal temperature, have been determined for the Heisenberg model of a ferromagnetic, for any spin value, S, and any lattice. The first five coefficients appropriate to the magnetic specific heat, C, have also been found. For the body-centred and face-centred cubic lattices, the χ and C coefficients are tabulated for half-integral S from $\frac{1}{2}$ to 3. From these coefficients estimates have been made of the reduced Curie temperatures, $\theta_C = kT_C/J$. It is found that for the simple, body-centred and face-centred cubic lattices the formula

$$\theta_C = \frac{5}{36}(z-1)(11X-1)$$

reproduces the estimated Curie temperatures fairly accurately. Here $X = S(S+1)$ and z is the lattice coordination-number. It is found that, suitably scaled, the theoretical curves for inverse susceptibility against temperature above the Curie point are rather insensitive to the spin value and to the precise lattice structure. The ratio of their initial to their final gradients is approximately 0.3. A comparison is made with the experimental values of χ^{-1} for both iron and nickel. If iron is represented by the Heisenberg model with S = 1, then the observed Curie temperature corresponds to a J value of 1.19×10^{-3} eV. Brief consideration is given to the use of the tabulated coefficients for antiferromagnetic problems.

538.2

13424. ISOTOPE SHIFT OF THE BASIC POINT IN THE HYDRIDE AND DEUTERIDE OF URANIUM.
A.I.Karchevskii, E.V.Artyushkov and L.I.Kikoin.
Zh. eksper. teor. Fiz., Vol. 36, No. 2, 636-7 (Feb., 1959).
In Russian.

Since the distance between the uranium ions is different in the two compounds there is a difference in the Curie points. Experiments described consisted in following the temperature variation of the residual magnetism of some ten pairs of specimens of hydride and deuteride by means of an astatic magnetometer. Cooling was carried out from room temperature down to the temperature of liquid nitrogen mainly in fields of 200 Oe. The Curie points obtained by extrapolating the straight part of the curve down to the temperature axis were consistent to within 0.1 to 0.2 degrees. The differences of the Curie points for the hydride and deuteride were some 4.0 ± 0.5 degrees, the deuteride Curie point being at 185° K approximately and hydride being higher. C.R.S.Manders

538.2

13425. MAGNETOCALORIC EFFECT IN THE HYDRIDE AND DEUTERIDE OF URANIUM. A.I.Karchevskii.
Zh. eksper. teor. Fiz., Vol. 36, No. 2, 638-9 (Feb., 1959).
In Russian.

Gives results of a more accurate determination of the Curie points of the hydride and deuteride of uranium (see preceding abstract) and their difference. These are found to be $\theta_{UH_3} = 182.0°$ K, $\theta_{UD_3} = 178.4°$ K, $\Delta\theta = 3.6 \pm 0.4$ deg. It is found in addition that these compounds differ in the magnitude of their magnetocaloric effects, for adiabatic magnetization at their Curie points the ΔT_m for the hydride is 1.6 times that for the deuteride. C.R.S.Manders

538.2

13426. ORIENTATION DEPENDENCE OF THE UNIAXIAL FERROMAGNETIC ANISOTROPY INDUCED BY MAGNETIC ANNEALING IN 20% Co—Ni SINGLE CRYSTALS.
K.Aoyagi, S.Taniguchi and M.Yamamoto.
J. Phys. Soc. Japan, Vol. 13, No. 5, 532-3 (May, 1958).

Measurements of the magnetic anisotropy of a magnetically annealed $(1\bar{1}0)$ disk of 20% Co—Ni alloy are described to test the theory of uniaxial anisotropy due to magnetic annealing developed independently by Néel and by the authors. The experimental procedure is briefly described. Representing the energy due to the induced uniaxial anisotropy by

$$E_u = -K\left(k_1 \sum_i \alpha_i^2\beta_i^2 + k_2 \sum_{i>j} \alpha_i\alpha_j\beta_i\beta_j\right)$$

where K, k_1, and k_2, are constants and α_i and β_i respectively are the direction cosines of the magnetization vector and the magnetic field applied during annealing, best agreement with the experiment results is obtained by putting k_2/k_1 equal to 3, whilst the theoretical value, assuming nearest neighbour interaction only, is k_2/k_1 equals 4. Work is proceeding in an attempt to discover the causes of the discrepancy for this alloy and for Ni_3Fe. S.A.Ahe

538

13427. MAGNETIC ANNEALING OF Fe_3Al SINGLE CRYSTAL. K.Suzuki.
J. Phys. Soc. Japan, Vol. 13, No. 7, 756-7 (July, 1958).

Torque curve measurements on a single crystal (110) disk of Fe_3Al, which had previously been subjected to magnetic annealing, are reported. These are compared with the Néel and Taniguchi—Yamamoto theory. If the anisotropy energy induced by magnetic annealing is represented by

$$E_u = -A_1 \sum_i \alpha_i^2\beta_i^2 - A_2 \sum_{i>j} \alpha_i\alpha_j\beta_i\beta_j$$

where α_i and β_i are the direction cosines of intrinsic magnetizatic and annealing magnetic field, respectively, and A_1 and A_2 are constants specified by the crystal structure, best agreement with experimental results is obtained by putting $A_1 = 2.9 \times 10^3$ erg cm and $A_2 = 9.8 \times 10^3$ erg/cm^3. The finite value for A_1 for a b.c.c. lattice is assumed to be due to second-nearest-neighbour interact Support is claimed for this assumption from unpublished results o experiments on magnetic anisotropy induced in Fe_3Al crystals by cold rolling. The ratio of the coefficients of dipole—dipole interaction between first-nearest neighbours, l_1, to that between second nearest neighbours, l_2, obtained from these experiments is 1.35:1 S.A.Ahe

53

13428. MEASUREMENT OF THE MAGNETIC ANISOTROPY OF EVAPORATED THIN NICKEL FILMS. W.Schüppel and Z.Málek.
Naturwissenschaften, Vol. 46, No. 13, 423-4 (1959). In German.

The induced uniaxial anisotropy was measured for films evaporated on either a hot (300°C) or cold substrate, and was fou to be much smaller for the hot substrate. E.P.Wohlfa

53

13429. MECHANISM FOR ANOMALOUS MAGNETOCRYSTALLI ANISOTROPY PEAKS IN FERROMAGNETIC CRYSTALS. C.Kittel
Phys. Rev. Letters, Vol. 3, No. 4, 169-70 (Aug. 15, 1959).

The strong peaks in the crystal anisotropy contribution to th ferromagnetic resonance field in yttrium iron garnet are interpre in terms of a crossing of the energy levels of the paramagnetic impurity ions in the uniaxial crystal and effective exchange fields The temperature dependence of the anisotropy field and the angul width is estimated. E.P.Wohlfa

538

13430. A NOTE ON THE NATURE OF DEMAGNETIZATION FACTOR HYSTERESIS. V.Hajko and J.Daniel-Szabó.
Czech. J. Phys., Vol. 8, No. 6, 685-8 (1958). In Russian.

Gives the results of measurements by the ballistic method o a cylindrical ferromagnetic rod of the curves $B, B_0 = f(d)$ for sl values of the external magnetic field, where B = magnetic inducti at a distance d from the centre of the rod and $|B_0|$ = simultaneou induction at the centre. The curves are used to throw light on th well known hysteresis exhibited by the demagnetization factor wh plotted against the magnetization in the centre of the rod. The curves indicate among other things that with B = O at the centre the rod the induction is in general non-zero at other points. This implies that the distribution of the magnetization J is always non- uniform along the rod, including the case when J = O at the centr This means in turn that a non-zero demagnetizing field and an infinite demagnetization factor can exist at the rod centre. D.E.Bro

53

13431. INTERPRETATION OF THE LOW-TEMPERATURE MAGNETIZATION CURVE OF ERBIUM GALLATE.
Y.Ayant and J.Thomas.

Acad. Sci. (Paris), Vol. 248, No. 13, 1955-6 (April 1, 1959).
ench.
A theoretical calculation is made of the magnetization curve rbium gallate. The magnetocrystalline anisotropy is calculated e basis of a distorted cubic crystal field. The form of the etization curve at low temperatures is then obtained using the ± 15/2 terms in the energy level states. There is a discrep- of 10 to 15% between the theoretical curve and experimental ts obtained by Pauthenet [J.Phys. Radium, Vol. 20, No. 2-3, Feb.-Mar., 1959).] It is suggested that this is due to neglect ner terms in the energy level states. S.A.Ahern

538.2

2. MAGNETO-CRYSTALLINE ENERGY OF A SINGLE STAL OF MAGNETO-PLUMBITE. G.Villers.
Acad. Sci. (Paris), Vol. 248, No. 21, 2973-5 (May 25, 1959).
ench.
The variation of magnetization with orientation of the magnetic with respect to the c-axis of a single hexagonal crystal of $_3O_3$.PbO shows a difficult direction of magnetization at an angle to the c-axis. This is associated with planes of maximum ity of iron ions. From magnetization curves of the single al, anisotropy constants $K_1 = 2.2 \times 10^6$, $K_2 = 1.4 \times 10^6$, 1.6×10^6 and $K_4 = 1 \times 10^5$ erg cm^{-3} are calculated.
A.J.Manuel

538.2

3. X-RAY STUDIES OF THE STRUCTURE OF THE FERRO-NETIC ALLOYS Fe—Mo AND Fe—Mo—Co.
..Pines and I.N.Barutkin.
Metallov. i Metallovedenie, Vol. 6, No. 5, 832-7 (1958).
ussian.
Specimens of these alloys were subjected to various thermal ments to produce a variety of coercivities (H_C). The profile of (211) K_α line was measured for each specimen and interpreted rms of microstresses and of the distribution of paramagnetic Mo_2 within the lattice. In Fe—Co high values of H_C are associ- with high internal stresses in the ferromagnetic phase, produced recipitation of Fe_3Mo_2. In Fe—Co—Mo the same conclusions y but H_C is also affected by finely dispersed inclusion of e_3Co_2. Agreement with a theory relating H_C to microstresses inclusions is fairly good. A.F.Brown

538.2

4 COERCIVITY OF γ-Fe_2O_3 POWDERS. E.P.Wohlfarth.
pl. Phys., Vol. 30, 1465-6 (Sept., 1959).
The coercivity of the acicular polycrystalline particles is dis- ed in terms of the chain of spheres model (Abstr. 2236 of 1956); effects of magnetocrystalline anisotropy and cobalt additions are considered. E.P.Wohlfarth

538.2

5. MEASUREMENT OF THE NOISE FROM CYCLIC REMAG-IZATION OF FERROMAGNETIC SUBSTANCES AT LOW IPERATURES. N.N.Kolachevskii.
eksper. teor. Fiz., Vol. 36, No. 2, 401-3 (1959). In Russian.
Results of measurement of the noise from cyclic remagnetiza- of ferromagnetic cores at temperatures between 2° and 300°K presented. No dependence of the noise on temperature was cted.

538.2

6. THE NATURE OF THE COERCIVE FORCE OF POLY-YSTALLINE FERROMAGNETIC MATERIALS. M.Rozenberg.
. de Physique (Bucarest), Vol. 4, No. 1, 85-92 (1959).
ussian.
The saturation magnetization (I_S), the constant of magnetocrys- ne anisotropy (K) and the constant of saturation magnetostriction are the only three temperature-dependent parameters appear- in theoretical expressions of coercive force; since their temp- ure dependence is known for a few ferromagnetic materials, temperature dependence of the coercive force of such materials studied to check the correctness of theory. Pure Ni and Fe alloys with 85, 78 and 50% Ni were investigated after rolling heat treatment, the testing temperatures lying in the interval n −195° to +300° C. It was found that, for Ni, the curve coercive- e/temperature is analogous to the relationship $\sqrt{K}/I_S$ by Gerlach str. 1758 of 1953) which does not follow from the stress theory, rather reminds one of the relationship foreseen in the start- l theory. It seems that, in highly-stressed polycrystalline omagnetics, the coercive force is caused by stresses in accord- ance with Neel's mechanism, while in annealed specimens it is due to the mechanism of the start-field type (by the growth of the demag- netization nuclei). F.Lachman

538.2

13437. THIN NICKEL FILMS WITH VERY LARGE COERCIVE FORCE AND HIGH ENERGY PRODUCT. W.Ruske.
Ann. Phys. (Leipzig), Folge 7, Vol. 3, No. 5-6, 323-6 (1959).
In German.
The dependence of the magnetic properties of cylindrical, electrolytically deposited Ni films (Abstr. 7164 of 1959) on axial pressure is studied in order to produce films of high coercive force H_C and energy product $(BH)_{max}$. The results show that films with $H_C = 10^3$ Oe and $(BH)_{max} = 3.5 \times 10^6$ gauss Oe can be obtained by a suitable deformation process. S.Weintroub

538.2 : 537.226.2

ANALOGY BETWEEN A FERROELECTRIC PHENOMENON AND A FERROMAGNETIC ONE: ATTENUATION OF FERROELECTRIC HYSTERESIS BY ORTHOGONAL POLARIZATION. See Abstr. 13262

538.2

13438. FILM THICKNESS AND TEMPERATURE DEPENDENCE OF THE COERCIVITY OF THIN EVAPORATED NICKEL FILMS MEASURED BY MEANS OF MAGNETORESISTANCE. W.Hellenthal.
Z. Naturforsch., Vol. 14a, No. 8, 722-7 (Aug., 1959). In German.
Reports results of magnetic and electron diffraction measure- ments on nickel films evaporated on glass at 20°, 200° and 400°C. The dependence of coercivity on thickness and temperature is interpreted in terms of strains, magnetocrystalline anisotropy and thermal fluctuations. The mean crystal size was found to lie between about 40 and 100 A; crystallite interactions also affect the coercivity. E.P.Wohlfarth

538.2

13439. THE INFLUENCE OF COLD ROLLING ON THE COERCIVE FORCE OF THIN IRON PLATES.
H.van Beelen, A.van Itterbeek and C.A.Velds.
Bull. Inst. Internat. Froid, Annexe 1958-1, 199-202.
The coercive force of films of thickness d between 3 and 100 μ varies as $d^{-1/3}$. E.P.Wohlfarth

538.2

13440. CHANGES OF LENGTH IN A MAGNETIC FIELD OF SOLIDS CONTAINING DISPERSED FERROMAGNETIC PARTICLES. G.Vogler.
Naturwissenschaften, Vol. 46, No. 13, 423 (1959). In German.
The change of length was measured as a function of the relative volume and shape factor of iron particles, and the results interpreted in terms of the particle interactions which give rise to an effective internal demagnetization. E.P.Wohlfarth

538.2

13441. THE MAGNETIC LAW OF APPROACH OF PLASTICALLY DEFORMED NICKEL AND NICKEL—COBALT SINGLE CRYSTALS. H.Kronmüller.
Z. Phys., Vol. 154, No. 5, 574-600 (1959). In German.
The differential susceptibility was measured as a function of temperature and deformation, and the results interpreted in terms of the stress fields surrounding dislocations. E.P.Wohlfarth

538.2 : 536.413.3

MAGNETOSTRICTION OF Mn and MnSb ALLOYS.
Abstr. 13219

538.2

13442. NEW MAGNETIC MATERIALS — GARNET FERRITES. K.P.Belov and M.A.Zaitseva.
Uspekhi fiz. Nauk., Vol. 66, No. 1, 141-4 (Sept., 1958). In Russian.
English translation in: Soviet Physics—Uspekhi (New York), Vol. 66(1), No. 1, 62-4 (Sept.-Oct., 1958).
The magnetic and crystalline properties of the newly developed magnetic garnets are discussed in the light of their probable applic- ations, and the knowledge which their study will add to the theories of magnetism and crystal chemistry. S.A.Ahern

538.2

13443. A RICHTER TYPE MAGNETIC LOSS IN YTTRIUM—IRON GARNET. H.Sekizawa, S.Iida and T.Miyadai.
J. Phys. Soc. Japan, Vol. 13, No. 6, 658 (June, 1958).
The loss tangent shows a peak at a temperature T°K for a frequency f. The relation between log f and 1/T is linear, giving an activation energy of 0.5eV. The peak can be removed by heat

4

treatment in air and is probably due to exchange of electrons between the normal ferric ions and some ferrous ions.

R.C.Kell

538.2 : 536.587

13444. USE OF THE CURIE POINT OF FERRITES FOR TEMPERATURE REGULATION. H.Straubel.
Z. angew. Phys., Vol. 11, No. 5, 172-4 (May, 1959). In German.

The Curie point of Mn–Zn ferrites depends critically on the Zn content, and the resulting temperature variation of the initial permability may be used in practical thermostatic devices.

E.P.Wohlfarth

538.2

13445. FERROMAGNETIC CERAMICS; PREPARATION OF FERRITES BY MEANS OF SOLID STATE REACTIONS.
P.V.Olcina Amador, F.Costell Landete and J.I.Fernández Alonso.
Rev. Cienc. apl., Vol. 13, No. 2, 120-9 (March-April, 1959).
In Spanish.

A chemical investigation by standard methods. L.Pincherle

538.2

13446. ANTIFERROMAGNETISM OF THE GAMMA PHASE OF IRON. E.I.Kondorskii and V.L.Sedov.
Zh. eksper. teor. Fiz., Vol. 35, No. 6(12), 1579 (Dec., 1958).
In Russian. English translation in: Soviet Physics–JETP (New York), Vol. 35(8), No. 6, 1104-5 (June, 1959).

The magnetic susceptibility of a f.c.c. iron alloy with 18% Cr and 9% Ni was investigated in the temperature range from 11.3°K to 109°K. An antiferromagnetic Curie point was found near 40°K. The bearing of this result on the f.c.c. phase of iron in the temperature range 910-1400°C is discussed. R.Parker

538.27

13447. DIPOLAR MAGNETODYNAMIC FERRITE MODES.
W.H.Steier and P.D.Coleman.
J. appl. Phys., Vol. 30, No. 9, 1454-5 (Sept., 1959).

The dipolar magnetodynamic modes of a ferrite rod placed between two conducting planes were investigated theoretically and experimentally. The mode characteristic equation was derived and mode charts calculated. These modes were experimentally observed for Ferramic R-1 in the ranges of 10 kMc/s and 18 kMc/s. The results are discussed from the point of view of using ferrite modes in parametric amplifiers and frequency multipliers.

S.A.Ahern

538.27

13448. FINE STRUCTURE IN THE DECLINE OF THE FERROMAGNETIC RESONANCE ABSORPTION WITH INCREASING POWER LEVEL. E.Schlömann and J.J.Green.
Phys. Rev. Letters, Vol. 3, No. 3, 129-31 (Aug. 1, 1959).

Experiments on single crystal yttrium and gadolinium garnet have shown that the saturation curve consists of a series of kinks superimposed on the normal steady decline of susceptibility. The results of a theory of this effect are discussed, from which a value for the exchange field can be deduced. D.J.Oliver

538.27

13449. LOW-TEMPERATURE LINE-WIDTH MAXIMUM IN YTTRIUM IRON GARNET.
E.G.Spencer, R.C.LeCraw and A.M.Clogston.
Phys. Rev. Letters, Vol. 3, No. 1, 32-3 (July 1, 1959).

The variation in ferromagnetic resonance line width with temperature was studied in yttrium iron garnet at 9300 Mc/s and 3000 Mc/s in the temperature range from room temperature to liquid helium temperature, to determine if the effect is intrinsic to ferromagnetic resonance and to determine its origin. It is shown that the low temperature line width maximum is an intrinsic property of the material, and is frequency dependent. Using single crystal specimens grown from specially purified yttrium oxide having total rare earth impurity of less than 0.1 part per million, the line width maximum is considerably reduced. The possible detailed interpretation of the observed temperature variation of the line width in this specimen is discussed. S.A.Ahern

538.27 : 534.232

EXCITATION OF HYPERSONIC WAVES BY FERROMAGNETIC RESONANCE. See Abstr. 13111

538.27

13450. EFFECTS OF RARE-EARTH IMPURITIES ON FERRIMAGNETIC RESONANCE IN YTTRIUM IRON GARNET.
J.F.Dillon, Jr and J.W.Nielsen.
Phys. Rev. Letters, Vol. 3, No. 1, 30-1 (July 1, 1959).

Experiments carried out on yttrium iron garnet (YIG) to find the causes of the observed variation of ferrimagnetic resonance line width with temperature (Abstr. 4540 of 1957), and the variati of resonance field with crystal direction (Abstr. 4812 of 1959) are described. A series of YIG crystals doped with each of the rare-earth ions were grown, and this paper reports the results obtaine using single crystals doped with terbium and europium. The crys growth procedure and experimental arrangement are described. mechanism responsible for the observed effects is discussed, and is shown that the line width peaks and anomalous anisotropy are d to the presence of rare earth impurities. S.A.Ah

538.

13451. A SIMPLE METHOD FOR INCREASING THE SENSITIVI OF A MICROWAVE PARAMAGNETIC RESONANCE SPECTRO-METER. P.Hedvig.
Acta phys. Hungar., Vol. 10, No. 1, 115-16 (1959).

538.

13452. APPLICATION OF THE DIFFUSION-MODIFIED BLOCH EQUATION TO ELECTRON SPIN RESONANCE IN ORDINARY AN FERROMAGNETIC METALS. J.I.Kaplan.
Phys. Rev., Vol. 115, No. 3, 575-7 (Aug. 1, 1959).

A new solution to the electron spin resonance absorption in metals is given by using Bloch's equation modified to include diffusion. It is shown that the coefficient for a similar diffusion ter added to the Landau-Lifshits equation for ferromagnetic resonan must be of order 10^{-5} times smaller than that for nonmagnetic metals. A restricted formula for saturation in nonmagnetic meta is given.

538

13453. ELECTRON SPIN RESONANCE OF Mn-ACTIVATED PHOSPHORS. O.Matumura.
J. Phys. Soc. Japan, Vol. 14, No. 1, 108 (Jan., 1959).

g-values and hyperfine coupling constants are reported for a series of phosphors. The magnitude of the hyperfine constant varies almost linearly with ionicity. E.F.W.Seymou

538

13454. ELECTRON SPIN RESONANCE OF Eu^{2+} IN NATURAL CaF_2 [WEARDALE FLUORITE]. O.Matumura, K.Hôrai and Z.Miduno.
J. Phys. Soc. Japan, Vol. 13, No. 7, 768-9 (July, 1958).

The measurements were made at 3 cm wavelength, and at ro temperature. Good agreement is obtained with the theoretical Hamiltonian by using an isotropic g-value of 1.993, and a crystalline cubic field splitting parameter a = 0.0186 cm^{-1}. The observed intensity ratios for the fine structure components are 7:20:14:30:15:18:7, compared with the theoretically predicted valu of 7:15:12:16:12:15:7 (both measured from high to low values of magnetic field). The authors state that the lack of agreement ma be due to impurities and imperfections in the crystals. It is mentioned in addition that some other weak rather complicated lines have been observed. S.A.Ah

538

13455. PARAMAGNETIC RESONANCE OF S-STATE IONS IN CALCIUM FLUORIDE. J.M.Baker, B.Bleaney and W.Hayes.
Proc. Roy. Soc. A, Vol. 247, 141-51 (Sept. 16, 1958).

Paramagnetic resonance has been observed in Mn^{2+}, Eu^{2+} an Gd^{3+} ions in single crystals of calcium fluoride grown from the m The Mn^{2+} ion has a very small cubic-field Stark splitting ($a = +0.6 \pm 0.4 \times 10^{-4}$ cm^{-1}), and a fluorine hyperfine structure o overall splitting of about 60 G due to some covalent bonding with fluorine ligands. The Eu^{2+} spectrum has cubic symmetry with splitting parameters $b_4 = 57.9 + 0.2$, $b_6 = 0.5 + 0.2$ ($\times 10^{-4}$ cm^{-1}), t the Gd^{3+} spectrum has tetragonal symmetry with much larger Sta splittings; neither ion shows a resolved fluorine structure. The manganese and europium hyperfine structures are closely the sa as in other salts with small covalent bonding.

538

13456. ELECTRON SPIN RESONANCE EXPERIMENTS ON SHALLOW DONORS IN GERMANIUM.
G.Feher, D.K.Wilson and E.A.Gere.
Phys. Rev. Letters, Vol. 3, No. 1, 25-8 (July 1, 1959).

The observation of electron spin resonances from both boun and non-localized electrons in germanium at frequencies of 9000 and 24 000 Mc/s in the temperature range 1.3° to 4°K is reporte

urements were made of g-values, line widths, and hyperfine
ings in the impurity concentration ranges of 8×10^{14} P/cm^3 to
P/cm^3, 10^{15} Sb/cm^3 to 3×10^{16} Sb/cm^3, and 5×10^{15} As/cm^3 to
As/cm^3. The results indicate that the ground states of the
ic and phosphorus donors in germanium are singlets.
S.A.Ahern

538.27

'. g FACTOR OF ELECTRONS IN GERMANIUM.
Roth and B.Lax.
. Rev. Letters, Vol. 3, No. 5, 217-19 (Sept. 1, 1959).
The g-factor of electrons on a single ellipsoidal energy surface
isotropic. A perturbation calculation with parameters deduced
experiment gave $g_{\parallel} \cong 0.9$; $g_{\perp} \cong 2.04 \pm 0.04$. Taking into
nt all the ellipsoids, the g-factor must be anisotropic in the
plane. The results of spin resonance experiments are dis-
d and shown to fit into the proposed scheme. The anisotropy
d show up best in the Zeeman effect of excitons.
L.Pincherle

538.27

3. ELECTRONIC PARAMAGNETIC RESONANCE IN ALLOYS
LKALI METALS. N.C.Garif'yanov and M.A.Starikov.
ksper. teor. Fiz., Vol. 35, No. 3(9), 798-9 (Sept., 1958).
ssian. English translation in: Soviet Physics—JETP
York), Vol. 35(8), No. 3, 553-4 (March, 1959).
The widths of the conduction electron resonances in sodium and
m alloys, measured at 290 Mc/s, are found to increase with
e concentration, extremely rapidly for lead, mercury and
l's alloy, and relatively slowly for light alkali metal solutes.
is consistent with a theoretically-expected reduction in
-lattice relaxation time by impurity atoms with strong
-orbit interaction. E.F.W.Seymour

538.27

9. MASERS. J.Weber.
mod. Phys., Vol. 31, No. 3, 681-710 (July, 1959).
A review article concerned mainly with solid-state masers for
nicrowave region. The well known expressions for the physics
aser operation are summarized; and the circuit behaviour, and
e properties are described. The properties required of active
rials for solid-state masers are discussed, and the character-
s of operational masers described. Later sections include a
ussion of gas masers, as well as microwave photon counters,
frequency and infra-red masers, optical pumping, and parametric
lifiers. The survey is completed by including the matrix ele-
and energy level data for ruby, prepared by Chang and Siegman
nford Electronics Lab., Stanford University, Tech. Rep. 156-2,
., 1958). S.A.Ahern

538.27

0. THEORY OF MASER OSCILLATION. J.C.Kemp.
pl. Phys., Vol. 30, No. 9, 1451-2 (Sept., 1959).
The mechanism responsible for the amplitude modulated nature
e signal from an inverted spin system undergoing maser
llation or coherent spontaneous emission (Abstr. 2653 and 5139
958) was studied theoretically. It is shown that the observed
eforms are due to large amplitude mutations of the magnetization
or. S.A.Ahern

538.27

1. STUDY OF THE OSCILLATION LEVEL OF A MASER
ILLATOR IN A STRONG FIELD. H.Benoit and C.Fric.
Acad. Sci. (Paris), Vol. 249, No. 4, 537-9 (July 27, 1959).
rench.
The oscillation level of a maser oscillator operating
inuously at a frequency of 29.66 Mc/s, and utilizing protons in
rrent of water whose macroscopic polarization is made
parallel to a steady magnetic field, is studied as a function of
ate of flow of the water, and the dependence explained
retically. E.F.W.Seymour

538.27

2. MULTILEVEL PULSED-FIELD MASER FOR GENERATION
HIGH FREQUENCIES. S.Foner, L.R.Momo and A.Mayer.
s. Rev. Letters, Vol. 3, No. 1, 36-8 (July 1, 1959).
A multilevel ruby maser has been operated at a frequency
er than the pump frequency by pulsing the magnetic field. The
llator was only about 50% greater than the pump frequency in
preliminary experiment but estimates are given for the
nced power and efficiency that should be obtained at around
m wavelength. D.Walsh

538.27

13463. ARE THE LANDAU LEVELS OF FREE CARRIERS USEFUL FOR A SUBMILLIMETRIC SEMICONDUCTOR MASER? D.Geist.
Z. Naturforsch., Vol. 14a, No. 8, 752 (Aug., 1959). In German.
It appears possible to apply the principle of adiabatic fast passage, of nuclear induction theory, to the Landau levels and to use the effect in an analogue of the two-level maser. A.H.W.Beck

538.27 : 539.19

13464. HYPERCONJUGATION IN THE ELECTRON RESONANCE SPECTRA OF FREE RADICALS. A.D.McLachlan.
Molecular Phys., Vol. 1, No. 3, 223-40 (July, 1958).
The electron resonance hyperfine splitting a_H produced by protons of a methyl group attached to one of the aromatic carbon atoms of a π-electron radical is calculated by the valence bond theory, treating the exchange interaction between the odd electron and the methyl group as a perturbation. The formula $a_H = Q\rho$ which relates a_H for a ring proton with the spin density ρ on the aromatic carbon atom also holds for methyl protons. Q is predicted to be positive with a theoretical value of about 28 gauss in the ethyl radical. Experimental data for several radicals indicate that Q is about 25 gauss. It is suggested that the CH_3 and CH_2 protons appear to be equivalent in the spectrum of the ethyl radical because Q has the same magnitude for both. The spectra of some Wurster's blue ions are interpreted on the assumption that hyperconjugation takes place between methyl groups and the nitrogen atoms.

538.27

13465. LOW TEMPERATURE NUCLEAR RESONANCE APPARATUS. A.G.Redfield.
Bull. Inst. Internat. Froid, Annexe 1958-1, 55-9.
A crossed-coil nuclear induction head for the temperature range 0.2 to 1.2°K obtained using helium and adiabatic demagnetization. It operates at 1 Mc/s and is intended for measuring metals. Signal to noise ratio in pure aluminium at 1°K is 50. Temperatures were measured both conventionally and by nuclear resonance; a slight unexplained difference was found. J.G.Powles

538.27

13466. CALCULATION OF THE NOISE/SIGNAL RATIOS FOR SOME SYSTEMS USED FOR THE RECORDING OF NUCLEAR RESONANCE. P.Dregichesku [Drăghicescu].
Rev. de Physique (Bucarest), Vol. 4, No. 1, 49-60 (1959). In Russian.
The quantitative comparison of the single-sweep [cf. Valeriu, Drăghicescu, Ianculovici and Drăghicescu, Stud. Cercetar. Fiz., Vol. 8, No. 2, 213-34 (1957)] and double-sweep block diagrams used for recording the nuclear magnetic resonance shows that, for a certain characteristic set of conditions, the noise/signal ratio for the former setup is about 150 times as large as that for the latter.
F.Lachman

538.27

13467. PARAMAGNETIC RESONANCE OF HYDROGEN [IN X-RAY IRRADIATED] FUSED SILICA.
J.S. van Wieringen and A.Kats.
Arch. Sci. (Geneva), Vol. 12, Special No., 203-4 (1959).
1959 Maxwell-Ampere Conference paper (see Abstr. 11542 of 1959).

538.27

13468. INDIRECT COUPLING AND RELAXATION TIME T_1 OF PROTONS IN A SOLUTION OF NH_4NO_3 IN A WEAK MAGNETIC FIELD. H.Benoit and H.Ottavi.
C.R. Acad. Sci. (Paris). Vol. 249, No. 1, 83-4 (July 6, 1959).
A maser of a type already described (Abstr. 8346-7 of 1959) was used. Three emission lines were obtained corresponding to the three resonance frequencies of the protons in a concentrated NH_4NO_3 solution in a magnetic field of 2.8 gauss. The relaxation time T_1 of protons coupled to oxygen atoms is comparable to that of those coupled to nitrogen atoms, and both are about 1.7 sec.
J.M.Baker

538.27

13469. PROTON MAGNETIC RESONANCE SPECTRA OF SYMMETRICAL HYDROGEN BONDS. S.Forsén.
J. chem. Phys., Vol. 31, No. 3, 852-3 (Sept., 1959).
The chemical shifts of the resonances of protons situated in symmetrical hydrogen bonds were determined for potassium and sodium hydrogen maleates and potassium hydrogen phthalate.
E.F.W.Seymour

538.27

13470. PROTON MAGNETIC RESONANCE STUDY IN AMMONIUM AND SILVER TRIHYDROGEN PERIODATES. R.Blinc.
J. chem. Phys., Vol. 31, No. 3, 849-50 (Sept., 1959).

Line width transitions have been observed in the spectra of the powdered salts. The transitions are interpreted as showing that there are protons, having two equilibrium positions in hydrogen bonds, and connected with the mechanism of antiferroelectricity in these substances. E.F.W.Seymour

538.27

13471. PROTON MAGNETIC RESONANCE OF AROMATIC CARBONIUM IONS. I. STRUCTURE OF THE CONJUGATE ACID. C.MacLean, J.H.van der Waals and E.L.Mackor.
Molecular Phys., Vol. 1, No. 3, 247-56 (July, 1958).

Nuclear magnetic resonance spectra of aromatic carbonium ions obtained by dissolving highly basic aromatic hydrocarbons in $CF_3COOH + H_2O$. BF_3 or $HF + BF_3$ were measured. The resonance of the protons in the CH_2 group in the carbonium ion was detected. It was concluded that this configuration, formed by the addition of the proton to the most reactive carbon atom in the hydrocarbon, has an "aliphatic" character. In most instances the n.m.r. spectra of the carbonium ions are blurred by exchange reactions. The character of these reactions is discussed.

538.27

13472. RING CURRENTS AND PROTON MAGNETIC RESONANCE IN AROMATIC MOLECULES. R.McWeeny.
Molecular Phys., Vol. 1, No. 4, 311-21 (Oct., 1958).

The molecular orbital theory is adapted to the calculation of magnetic shielding constants in aromatic molecules. The usual LCAO perturbation theory is generalized to take account of the imaginary perturbation due to an external magnetic field. The induced field at a point is then calculated by inserting a test dipole, adopting approximations due to London, and using the perturbation theory to evaluate a coupling energy. The results differ somewhat from those obtained in a rather different manner by Pople.

538.27

13473. HIGH RESOLUTION HYDROGEN RESONANCE SPECTRA OF TRISUBSTITUTED BENZENES. R.E.Richards and T.Schaefer.
Molecular Phys., Vol. 1, No. 4, 331-42 (Oct., 1958).

High-resolution hydrogen resonance spectra are given for a number of asymmetrically trisubstituted derivatives of benzene. In some cases the spectra can be analysed as AB_2, ABB' or ABX cases. The ABB' case, in which the B nuclei have identical chemical shifts but are unequally coupled to A, is discussed and illustrated. The spin–spin coupling constants between protons (a) ortho to one another lie in the range 7 to 9 c/s, (b) meta to one another occur near 2.5 c/s and (c) para to one another are less than 1 c/s.

538.27

13474. HIGHER ORDER TRANSITIONS IN DOUBLE NUCLEAR RESONANCE EXPERIMENTS IN SOLIDS. N.Bloembergen.
J. Phys. Soc. Japan, Vol. 13, No. 6, 660 (June, 1958).

A mechanism is proposed and developed to explain the anomalous results observed by Saito (Abstr. 8357 of 1959) from nuclear magnetic resonance experiments on TlF and TlBr. S.A.Ahern

538.27

13475. NUCLEAR MAGNETIC RESONANCE IN DILUTE Cu–Mn ALLOYS. W.van der Lugt, N.J.Poulis and W.P.A.Hass.
Arch. sci. (Geneva), Vol. 12, Special No., 243-5 (1959).

1959 Maxwell-Ampere Conference paper (see Abstr. 11542 of 1959).

538.27

13476. NUCLEAR MAGNETIC RESONANCE STUDIES OF WATER SORBED ON FIBROUS MATERIALS. A.Odajima.
J. Phys. Soc. Japan, Vol. 14, No. 3, 308-12 (March, 1959).

Water molecules sorbed on "mulberry paper" were studied. The line-width measurements were made for water content ranging from 10 to 180% at 20°C, using a Varian high-resolution spectrometer. Within the range 10-20%, the line widths rapidly decreased with increasing water content, and gradually decreased beyond this range. Although this variation was similar to that of the dielectric relaxation, the experimental value of τ_N obtained from Kubo–Tomita equation was much greater in the order of magnitude than that of the dielectric relaxation time τ_D. Therefore, τ_N and τ_D do not satisfy the relation $\tau_N = \tau_D/3$. This suggests that the water molecules in the sorbed state do not rotate with spherical symmetry, as in the liquid state.

538.2

13477. NUCLEAR MAGNETIC RESONANCE SPECTRA OF COMPOUNDS OF THE B-SUBGROUP METALS. L.E.Orgel.
Molecular Phys., Vol. 1, No. 4, 322-5 (Oct., 1958).

The paramagnetic contributions to the susceptibilities of compounds of B-subgroup ions and the chemical shifts observed in their nuclear magnetic resonance spectra are shown to depend on interconfigurational mixing brought about by environments of less than cubic symmetry. Order of magnitude calculations are made for Pb^{2+} compounds and agree reasonably well with experiment.

538.2

13478. HIGH RESOLUTION NUCLEAR MAGNETIC RESONANCE SPECTRUM OF 1-BUTYNE. B.Braillon and R.Romanet.
Arch. Sci. (Geneva), Vol. 12, Special No., 234-7 (1959). In French.

1959 Maxwell-Ampere Conference paper (see Abstr. 11542 of 1959).

538.2

13479. NUCLEAR MAGNETIC RELAXATION IN POLYETHYLEN DEUTEROTEREPHTHALATE. I.M.Ward.
J. chem. Phys., Vol. 31, No. 3, 858-9 (Sept., 1959).

T_2 deduced from the line width and T_1 by saturation for proto at 25 Mc/s in the temperature range −180°C to 130°C for polyethy lene deuteroterephthalate studied with a view to observing the mo of the methylene protons. In the line-narrowing temperature regi but not elsewhere, T_1 corresponds to an apparent activation energ of 2 kcal/mole which is stated to be reasonable for hindered rotati of methylene groups in the amorphous regions but differs greatly from activation energies of dynamic and dielectric processes. J.G.Powl

538.

13480. NUCLEAR MAGNETIC RESONANCE SPECTRA OF 1,10-PHENANTHROLINE AND SOME METHYLATED 1,10-PHENANTHROLINES. K.Ito, T.Isobe and K.Sone.
J. chem. Phys., Vol. 31, No. 3, 861-2 (Sept., 1959).

The effect of an asymmetric π-electron charge distribution o the chemical shifts of the ring protons is studied. E.F.W.Seymo

538.27 : 536.41

NUCLEAR MAGNETIC RESONANCE IN PARTIALLY CRYSTALLINE POLYPROPYLENE, POLY(BUTENE-1) AND POLY(PENTENE-1). See Abstr. 13220

538.

13481. REMOVAL OF DIPOLAR BROADENING OF NUCLEAR MAGNETIC RESONANCE SPECTRA OF SOLIDS BY SPECIMEN ROTATION. E.R.Andrew, A.Bradbury and R.G.Eades.
Nature (London), Vol. 183, 1802-3 (June 27, 1959).

The splitting of the Na^{23} resonance of a crystal of sodium chloride into central and "sideband" resonances on rotation of the crystal at 810 c/s (Abstr. 5948 of 1959) has been observed for a range of angles, α, between the rotation axis and the applied mag netic field. The central component is narrowed, the dipolar broad ening being entirely removed when $\alpha = \cos^{-1}(1/\sqrt{3})$. E.F.W.Seymo

538.

13482. NUCLEAR SPIN RELAXATION TIME IN SUPERCONDUCTING ALUMINUM. A.G.Redfield.
Phys. Rev. Letters, Vol. 3, No. 2, 85-6 (July 15, 1959).

Measurements were made at temperatures down to 0.4 T_c, using a method similar to that of Hebel and Slichter (Abstr. 192 o 1958). The relaxation time first fell and then rose again as the te erature was lowered, and the results agree closely with the predi tions of the B.C.S. theory, as applied to this problem by Hebel an Slichter, if one adjustable parameter is suitably chosen. R.G.Chambe

538

13483. NUCLEAR ORIENTATION BY OPTICAL PUMPING OF T ISOTOPES Hg^{201} and Hg^{199} AND MEASUREMENT OF THEIR MAGNETIC MOMENTS BY NUCLEAR MAGNETIC RESONANCE. B.Cagnac and J.Brossel.
C.R.Acad. Sci. (Paris), Vol. 249, No. 1, 77-9 (July 6, 1959).
In French.

Experiments, like those described in Abstr. 6213 (1958), sho that the relaxation time for Hg^{201} is much shorter than that for Hg this is ascribed to an electric quadrupole moment, interacting wi transient field gradients. The ratio of the magnetic moments of t

otopes is found to be significantly different from that given by measurements, suggesting an anomaly in the h.f.s.
J.Hawgood

538.27

TRANSIENT PHENOMENA AND NUCLEAR RELAXATION PTICALLY ORIENTED Hg^{199}. B.Cagnac and J.Brossel. Acad. Sci. (Paris), Vol. 249, No. 2, 253-5 (July 15, 1959). ench.
Describes optical pumping and magnetic resonance experiments, ich the longitudinal and transverse relaxation times were ured. The orientation is produced by the method of the ding abstract. J.Hawgood

538.27

MOLECULAR MOTION IN DICHLOROETHANE. J.L.Ragle. . Sci. (Geneva), Vol. 12, Special No., 177-8 (1959). 959 Maxwell-Ampere Conference paper (see Abstr. 11542 of 5).

538.27

NUCLEAR QUADRUPOLE RESONANCE IN SOLID 1,2-OMOETHANE. H.W.Dodgen and R.E.Anderson. em. Phys., Vol. 31, No. 3, 851-2 (Sept., 1959).
The temperature dependence of the Br^{81} resonance frequency in olid is interpreted as due to the onset of rapid molecular entation about the Br–Br axis. E.F.W.Seymour

538.27

ZEEMAN EFFECT OF NUCLEAR QUADRUPOLE ONANCE SPECTRUM IN CYANURYL CHLORIDE. rino, T.Chiba, T.Shimozawa and M.Toyama. ys. Soc. Japan, Vol. 13, No. 8, 869-79 (Aug., 1958).
A study on the Zeeman effect of Cl^{135} nuclear quadrupole nance spectrum was carried out on a single crystal of cyanuryl ride. Three distinct q-tensors were found in this crystal, two em being equivalent. The directions of the principal axes were mined within an accuracy of 1°. It was concluded that in the tal all molecules are disposed parallel (or antiparallel) to one er and three C–Cl bonds of a molecule are on a plane, making gle of 120° with one another, one of them being not equivalent e other two. A large asymmetry parameter (0.26) was obtained. n the coupling constant and the asymmetry parameter, the le bond character and the ionic character of C–Cl bonds were nated to be 10% and 17%, respectively. The large double bond acter was considered to be associated with the large electro-tivity of nitrogen atoms in the ring.

538.27

8. DIPOLAR BROADENING OF THE QUADRUPOLE ONANCE LINE IN CRYSTALS $NaClO_3$, $NaBrO_3$. K.Kano. hys. Soc. Japan, Vol. 13, No. 9, 975-8 (Sept., 1958).
Formulae are derived for the contribution of the dipolar broad-g to the second moment of the resonance line in pure quadrupole nance experiment for crystals in which the following conditions satisfied: (1) All nuclear spins involved, both resonant and esonant, have spin 3/2. (2) The electric field gradient tensor l nuclear sites have axial symmmetry. For resonant nuclei radient of the electric field has the same magnitude but the metry axes of the electric field gradient at several nuclear sites e unit cell have different directions. (3) For non-resonant ei, no restriction has been set on the magnitude of the electric gradient and its directions. A comparison is made with the widths observed by Koi et al.

538.27

9. NUCLEAR QUADRUPOLE RESONANCE IN METALLIC IUM. R.R.Hewitt and W.D.Knight. s. Rev. Letters, Vol. 3, No. 1, 18 (July 1, 1959).
Using a sample of annealed indium spheres (2-4 μ diameter) in tz powder the resonances for In^{115} and In^{113} were observed and quadrupole coupling constants at 4.2°K deduced. The interest ie result is discussed. D.J.Oliver

538.27

0. WIDTH OF THE QUADRUPOLE-RESONANCE LINES OF LORINE IN BARIUM, SODIUM AND POTASSIUM CHLORATES. Grechishkin. eksper. teor. Fiz., Vol. 36, No. 2, 630-2 (Feb., 1959). ussian.

The author observed the resonance at room temperature by means of a frequency-modulated superregenerator, a narrow-band low-frequency amplifier and a phase detector. It was found that the line width is determined principally by the dipole–dipole interaction between the nuclei. F.Lachman

538.27 : 536.424

DETECTION OF A NEW PHASE IN PARADICHLOROBENZENE BY Cl^{35} PURE QUADRUPOLE RESONANCE. See Abstr. 13226

ELECTROMAGNETISM
MAGNETOHYDRODYNAMICS

538.3

13491. ELECTROMAGNETIC EQUATIONS IN GENERALIZED UNITS. G.L.Trigg.
Amer. J. Phys., Vol. 27, No. 7, 515-16 (Oct., 1959).
The work of Berreman (see Abstr. 1591 of 1959) is extended by making the equations valid in the Gaussian and Heaviside–Lorentz systems and by adding other relations of importance or interest.

538.3

13492. ELECTRODYNAMIC CONTAINMENT OF CHARGED PARTICLES BY THREE-PHASE VOLTAGES.
R.F.Wuerker, H.M.Goldenberg and R.V.Langmuir.
J. appl. Phys., Vol. 30, No. 3, 441-2 (March, 1959).
A system of electrodes and voltages which gives cubical symmetry is described and analysed. Experimental data are in accurate agreement with the analysis. C.G.Morgan

538.3 : 530.12

STRUCTURE OF THE ELECTROMAGNETIC FIELD. See Abstr. 12983

538.3 : 532.5

13493. HYDROMAGNETIC EQUILIBRIUM. III. AXISYMMETRIC INCOMPRESSIBLE MEDIA. L.Woltjer.
Astrophys. J., Vol. 130, No. 2, 400-4 (Sept., 1959).
For Pt II see Abstr. 11278 (1959). Equilibrium configurations in an incompressible hydromagnetic medium, in which axial symmetry prevails, are discussed. The full formal solution is obtained directly from the equilibrium equations. A variational formulation of the equilibrium problem is shown to lead to the same solution.

538.3 : 532.5

13494. HYDROMAGNETIC EQUILIBRIUM. IV. AXISYMMETRIC COMPRESSIBLE MEDIA. L.Woltjer.
Astrophys. J., Vol. 130, No. 2, 405-13 (Sept., 1959).
The hydromagnetic equations for an axisymmetric polytropic medium are transformed into six scalar equations. A partial solution of these equations is obtained for the case of equilibrium. A complete set of integrals of the axisymmetric hydromagnetic equations is given. It is shown that these integrals may be made the basis of a variational principle characterizing the states of equilibrium as states of extremal energy with respect to the set of integrals.

538.3 : 532.5

13495. EXACT SIMILARITY SOLUTIONS OF THE MAGNETO-HYDRODYNAMIC EQUATIONS OF MOTION. N.N.Kochina.
Dokl. Akad. Nauk SSSR, Vol. 126, No. 3, 528-31 (May 21, 1959).
In Russian.
Unsteady motion of an ideal polytropic gas with zero thermal and infinite electrical conductivity, with plane or cylindrical symmetry,is considered. To obtain similarity solutions, it is assumed that all dependent variables have the form

$$(1)\ t^n f[(\tau/t)\exp(r/r_0)]$$

or

$$(2)\ r^m t^n f[(r/r_0)\exp(-t/\tau)],$$

where τ, r_0 are constants, but m, n, and f[ ] are different for different dependent variables. For the form (1), which applies only for plane symmetry (r = distance), the equations of motion can now be reduced to quadrature with the help of the adiabatic, energy, and flux conservation laws. Solutions obtained by this method are presented

graphically, first for a shock wave starting at t = 0 from the point r = −∞, and secondly for the motion resulting from an initial state with exponential spatial density variation. The formulae arising in the corresponding calculation for case (2) (plane or cylindrical symmetry) are also given. O.Penrose

538.3 : 532.5

13496. AN APPROXIMATE METHOD FOR THE INVESTIGATION OF PLANE VORTEX FLOW IN MAGNETOHYDRODYNAMICS. I.I.Nochevkina.
Dokl. Akad. Nauk SSSR, Vol. 126, No. 6, 1220-3 (June 21, 1959). In Russian.

The magnetic field is perpendicular to the plane of vortex in a perfectly conducting gas. By introducing a new expression for the gas pressure (in terms of density), the author is able to reduce, under carefully stated conditions, the nonlinear differential equations of magnetohydrodynamics to an ordinary differential equation of the Bessel type. J.K.Skwirzynski

538.3 : 532.5

13497. STATIONARY FLOW OF AN INFINITELY CONDUCTING GAS ROUND A CORNER. G.A.Lyubimov.
Dokl. Akad. Nauk SSSR, Vol. 126, No. 4, 733-5 (June 1, 1959). In Russian.

Isentropic stationary flow is treated using cylindrical coordinate with axis along the corner. All dependent variables are assumed to depend on the angle ϕ only. The flow is not, in general, plane. A solution termed a "rotating Prandtl—Mayer wave" is obtained, in which p, ρ, and H^2 are constants, and v_z is an arbitrary function of ϕ. Another type of solution refers mainly to the case where the corner is infinitely conducting so that the magnetic field must be tangential at the surface; here it is assumed that H = const. ρv, and the hydromagnetic equations are reduced to a single first-order ordinary differential equation by using ρ as independent variable. For the case where the corner is non-conducting, the above simplification does not apply, but an integral of the hydromagnetic equations is given, which can be used to reduce their order. O.Penrose

538.3 : 532.5

13498. SOME EXACT SOLUTIONS OF THE MAGNETO-GASODYNAMIC EQUATIONS IN THE PRESENCE OF GRAVITATIONAL FORCES AND ZERO TEMPERATURE GRADIENT. E.V.Ryazanov.
Dokl. Akad. Nauk SSSR, Vol. 126, No. 6, 1224-6 (June 21, 1959). In Russian.

A circularly cylindrical, symmetrical system (with r, z, φ coordinates), as described, has exact solutions, which are derived here when: (1) $H_z \neq 0$, $H_\phi = 0$; (2) $H_z = 0$, $H_\phi \neq 0$; (3) $H_z \neq 0$, $H_\phi \neq 0$, where H_z and H_ϕ are the components of the magnetic field. The solutions are then applied to shockwave conditions.

J.K.Skwirzynski

538.3 : 532.5 : 550.38

13499. ON THE INTERACTION OF CONDUCTIVE PARTICLE STREAMS WITH THE EARTH'S MAGNETIC FIELD. V.N.Zhigulev and E.A.Romishevskii.
Dokl. Akad. Nauk SSSR, Vol. 127, No. 5, 1001-4 (Aug. 11, 1959). In Russian.

This paper follows a previous communication of the first author (Abstr. 11275 of 1959). The authors consider effects of earth's motion in its orbit through interplanetary ionized gas and the interaction of particles emitted by the sun with earth's magnetic field. In particular they obtain the shape and size of a surface S within which the interaction takes place; the characteristic dimension l^* of S is estimated, as well as the force and the moment acting on the magnetic dipole of the earth. A table gives values of l^*, of the ordinary and the magnetic Reynold's numbers of particle stream for several values of the particle density and temperature.

J.K.Skwirzynski

538.3 : 532.5

13500. MAGNETOHYDRODYNAMIC PHENOMENA ON THE TERRESTRIAL LABORATORY SCALE. I.M.Kirko.
Elektrichestvo, 1959, No. 4, 9-16 (April). In Russian.

Gives a short review of basic principles, including the motion of lines of force in a perfect conductor, the use of dimensionless numbers, Alfvén waves, and a qualitative boundary layer theory. Two magnetohydrodynamic pumps are then described: a "conduction" pump using crossed electric and magnetic fields, and an "induction" pump using a travelling sinusoidally varying magnetic field. Theoretical relations connecting pressure gradient and flow-rate are obtained for laminar flow in both pumps. Experimental results are also given for both laminar and turbulent flow in the conduction pump. An experimental formula for the pressure gradient produced by the induction pump for turbulent flow is given. Finally the role of Joule heating both in pumps and in thermonuclear reactors is discussed very briefly. O.Penrose

538.3 : 532

13501. THERMODYNAMICS OF ELECTRICALLY CONDUCTING FLUIDS. Boa-Teh Chu.
Phys. of Fluids, Vol. 2, No. 5, 473-84 (Sept.-Oct., 1959).

By consideration of the equations of motion and the electromagnetic theory of a moving medium, the reversible work done on a fluid, per unit mass, in a small change of state is shown to be $-pd(1/\rho) + E \cdot d(D/\rho) + H \cdot d(B/\rho)$, where p is the pressure due to the joint action of the mechanical and electromagnetic changes; ρ the density; E and B are, respectively, the electric field strength and magnetic induction; D and H are, respectively, the electric and magnetic excitation. Only the nonrelativistic version of Minkowski theory has been used in this derivation. This formula provides the basis for a complete study of the thermodynamics of fluid medium under the action of both electromagnetic and mechanical changes. As an application, basic formulae which may be used to calculate the electrocaloric effect, the magnetocaloric effect, and electro- and magnetostriction effects are deduced. In particular, the additional pressure and ponder-motive force due to these effects are obtained in a simple manner which, from the thermodynamic point of view, is better than Kortweg and Helmholtz' derivation given in the classical electromagnetic theory. As a second application, the energy equation of magnetohydromechanics is derived. The derivation is more general than previous derivations in that it does not presuppose the form of the electromagnetic constitutive equations (e.g., $D = \epsilon E$, $B = \mu H$) which the medium satisfies.

538.3 : 532

13502. SHOCK WAVES [IN ASSOCIATION] WITH A DISCONTINUITY OF THE [ELECTRIC] CONDUCTIVITY OF A GAS IN AN ELECTROMAGNETIC FIELD. G.A.Lyubimov.
Dokl. Akad. Nauk SSSR, Vol. 126, No. 2, 291-4 (May 11, 1959). In Russian.

Considering stationary shock waves in a flowing gas, it is assumed that the insulating gas is ionized in the wave-front so that it becomes a perfect conductor. An electrostatic and a magnetostatic field are applied to the insulating portion of the gas. From the principles of electromagnetism and aerodynamics, the pressure volume relation in the flowing gas is derived and the result is discussed. R.Eisenschi

538.3 : 532

13503. THE CALCULATION OF SHOCK WAVES IN MAGNETOHYDRODYNAMICS. M.I.Kiselev.
Dokl. Akad. Nauk SSSR, Vol. 126, No. 3, 524-7 (May 21, 1959). In Russian.

The shock conditions for an ideal gas, with isentropic law $p = A\rho^k$, are dealt with algebraically. For perpendicular shocks the velocity, density, magnetic field, etc. behind the shock are obtained in terms of their values in front by reducing the shock conditions to quadratic equations. These results are generalized to an "oblique shock" in which the field is parallel to the front and perpendicular to the plane of motion; the equation of the shock polar is derived and the graphs of a family of shock polars are given. A similar method can be used when the field is not parallel to the shock front, but it leads to a cubic equation. It is shown how the shock conditions for perpendicular shock can be interpreted geometrically using a 3-dimensional space whose axes are the gas speed, the sound speed, and the Alfvén speed. O.Penro

538.3 : 532

13504. COLLISIONLESS PLASMA SHOCK. S.A.Colgate.
Phys. of Fluids, Vol. 2, No. 5, 485-93 (Sept.-Oct., 1959).

The structure of an extremely strong magnetohydrodynamic shock is discussed in the limit of no particle collisions. It is tentatively concluded that the shock transition takes place through the mechanism of a strong electric field produced by charge separation. The pressure in the shocked plasma is due primarily to a very high electron temperature. The entropy increase occurs by Landau damping of the coherent electron oscillation. The ions, on the other hand, undergo an irreversible temperature change of only 3.

538.3 : 532.5

SIMPLE MAGNETOACOUSTIC WAVES.
Lyubarskii and R.V.Polovin.
sper. teor. Fiz., Vol. 35, No. 2(8), 509 (Aug., 1958).
sian. English translation in: Soviet Physics—JETP (New
Vol. 35(8), No. 2, 351 (Feb., 1959).
is stated that points of high density move more rapidly than
of low density if $\partial^2(\rho^{-1})/\partial p^2 > 0$. Some elementary conclu-
are drawn. O.Penrose

538.3 : 532.5

THE IMPOSSIBILITY OF RAREFACTION WAVES IN
NETOHYDRODYNAMICS. R.V.Polovin and G.Ya.Lyubarskii.
sper. teor. Fiz., Vol. 35, No. 2(8), 510 (Aug., 1958). In
an. English translation in: Soviet Physics — JETP (New
, Vol. 35(8), No. 2, 351-2 (Feb., 1959).
For an arbitrary direction of the magnetic field, it is stated
shock wave must increase the density provided that
$(\rho^{-1})/\partial p^2]_S > 0$ and $(\partial p/\partial T)_\rho > 0$; also that it will increase a
magnetic field but decrease a large one. O.Penrose

ELECTROMAGNETIC WAVES AND OSCILLATIONS

538.561 : 621.375.9

NOISE FIGURE OF REACTANCE CONVERTORS AND
AMETRIC AMPLIFIERS. A.van der Ziel.
pl. Phys., Vol. 30, No. 9, 1449 (Sept., 1959).
Gives a simple derivation of the noise figure for these devices
corrects a result of Heffner and Wade (Abstr. 8940 of 1958).
A.H.W.Beck

538.561

INDUCED AND SPONTANEOUS EMISSION IN A COHERENT
I.D. II. I.R.Senitzky.
. Rev., Vol. 115, No. 2, 227-37 (July 15, 1959).
For Pt I, see Abstr. 474 (1959). The interaction between the
romagnetic field and a number of identical atomic systems,
idually characterized by an electric dipole moment and two
gy levels, is analysed for the case where the atomic systems
nside a lossy cavity and exposed to a coherent driving field,
nance being assumed between atomic system, cavity, and driving
The problem of introducing loss into a quantum-mechanical
alism is treated first. Formal operator expressions are
ned for the field variables which include the absorption and the
uation (both thermal and quantum-mechanical) effects of the
mechanism. Expectation values are then obtained for the field
gth and the field energy which are valid for times short com-
d to the lifetime of the excited state. It is shown that the spon-
ous-emission energy in the field increases initially as the
re of the time and approaches a steady-state value after a
ient period which is of the order of the cavity relaxation time.
induced emission contains two parts: incoherent emission
ed by the thermal field, and coherent emission induced by the
ng field. The incoherent induced-emission energy has the same
dependence as the spontaneous-emission energy, and the ratio
e former to the latter is the number of photons in the thermal
cing) field. The coherent induced-emission energy does not
oach a steady-state value, but, after a transient period,
eases linearly with the time. The ratio of the coherent induced-
sion energy to the spontaneous-emission energy is equal,
ally, to the number of photons in the driving-field energy, but
mes βt times as large after the transient period, where β is
eciprocal of the cavity relaxation time. The expectation value
e rate of energy emission by the atomic systems is also obtained.
shown that the ratio of the downward to the upward transition
abilities has the well-known value of $(n + 1)/n$, where n is the
energy in units of the photon energy, only in the absence of a
rent field.

538.561 : 539.17

RADIO EMISSION FROM AN ATOMIC EXPLOSION. See
tr. 12700

538.561 : 551.594.6 : 621.396.821

V.L.F. ATMOSPHERICS. TRAVELLING WAVE AMPLIFI-
ION. See Abstr. 13974

538.566

13509. INTEGRAL EQUATION OF THE SECOND KIND FOR THE PROBLEM OF DIFFRACTION BY AN INFINITELY THIN SCREEN.
A.Ya.Povzner and I.V.Sukharevskii.
Dokl. Akad. Nauk SSSR, Vol. 127, No. 2, 291-4 (July 11, 1959).
In Russian.

Diffraction of an electromagnetic wave by a finite, thin, ideally conducting screen is formulated by means of a dyadic Green function, leading to a Fredholm integral equation of the 2nd kind over the boundary of the screen. The method is also applied to a scalar solution for both the Dirichlet and the Neumann boundary conditions.
J.K.Skwirzynski

538.566 : 621.372.8

13510. PERTURBATION OF WAVE GUIDES AND CAVITIES BY SPHERES AND CYLINDERS. W.Hauser and L.Brown.
J. appl. Phys., Vol. 30, No. 9, 1460-1 (Sept., 1959).

An integral equation technique is used to obtain an estimate of the effect of a plane wall on the electromagnetic fields within a cylinder or sphere a short distance from the wall. This yields an estimate for the accuracy of a free space calculation. A specific result for a ferrite sphere is given. D.Walsh

538.566

13511. THE "BACKWARD WAVE" IN A METALLIC WAVEGUIDE, WHICH IS FILLED WITH LONGITUDINALLY MAGNETIZED PLASMA.
W.O.Schumann.
Z. angew. Phys., Vol. 11, No. 9, 333-5 (Sept., 1959). In German.

Analyses damping effect of collisions with neutral gas molecules on the propagation of waves with oppositely-directed phase and group velocity, using results of earlier papers (Abstr. 2449 of 1957; 2544 of 1959). Deals with the apparent anomaly that these waves increase in amplitude in the direction of the phase velocity, whether the latter is forward or backward. B.Meltzer

538.566 : 621.396.677.833.2

13512. INTEGRAL EQUATIONS FOR AERIALS WHICH HAVE ROTATIONAL SYMMETRY AND SURFACE IMPEDANCE.
N.N.Govorun.
Dokl. Akad. Nauk SSSR, Vol. 126, No. 1, 49-52 (May 1, 1959).
In Russian.

Equations of the first and second degree are obtained for the intensity of electric current in an aerial with surface impedance. The aerial body has rotational symmetry and is placed in an infinite medium; the generating field is arbitrary. Both meridional and azimuthal currents are formulated as solutions of integral equations. The equations of the first degree result when the currents are independent of azimuthal angles and when only zeroth and first harmonics of meridional angles are considered. A method of solution by expansion in terms of conductivity is suggested.
J.K.Skwirzynski

538.566 : 621.396.677.73

13513. A CONTRIBUTION TO THE THEORY OF HORNS.
A.M.Dykhne.
Dokl. Akad. Nauk SSSR, Vol. 126, No. 6, 1232-3 (June 21, 1959).
In Russian.

The method used and results obtained by Pokrovskii, Ulinich and Savvinykh [Abstr. 5396B of 1958; Dokl. Akad. Nauk SSSR, Vol. 120, No. 3, 504-6 (1958)] dealing with the reflection and dissipation of waves by the local form "defects" of a flat waveguide are applied to horns. F.Lachman

538.566.2

13514. TRANSFER OF TRANSIENT ELECTROMAGNETIC SURFACE WAVES INTO A LOSSY MEDIUM. J.Keilson and R.V.Row.
J. appl. Phys., Vol. 30, No. 10, 1595-8 (Oct., 1959).

The propagation of a transient surface wave in the form of an impulse into a lossy medium is examined via a simple two-dimensional plane-wave model. The solution found exhibits characteristics of both wave propagation and diffusion. This impulse response is used as a basis for calculating the response to an arbitrary excitation at a point on the surface. For observation times longer than the time duration of the surface disturbance, the form of this solution is equivalent to a moment expansion. The limits imposed on the signalling band width by the losses in the medium are discussed.

538.566.2 : 537.56

PROPAGATION OF ELECTROMAGNETIC WAVES IN COMPLETELY IONIZED RESISTIVE PLASMAS. See Abstr. 13395

538.566.2

13515. RADIO ECHOES FROM SOME INVISIBLE OBJECTS IN THE TROPOSPHERE. A.G.Gorelik and V.V.Kostarev.
Dokl. Akad. Nauk SSSR, Vol. 125, No. 1, 59-61 (1959). In Russian

Observations were made between 1956 and 1958 on 3.2 cm, using a parabolic reflector of 20 m diameter. The echoes are of two kinds - random and horizontal or inclined layers. Maximum number of echoes occurred between 13.00 and 15.00 hr.

J.M.Hough

NUCLEAR AND ATOMIC PHYSICS

539.1

13516. ISOTOPIC SPIN. J.P.Davidson.
Amer. J. Phys., Vol. 27, No. 7, 457-65 (Oct., 1959).

The isotopic (or isobaric) spin formalism, so important in nuclear structure and meson problems, is developed. After a short introduction the Pauli theory of mechanical spin is reviewed and then this formalism is used to develop the isotopic spin formalism along parallel lines. Finally, some examples of the formalism's applications to beta decay and nuclear reaction problems are given.

539.1 : 537.54

RESEARCH PROGRAMME FOR THE ITALIAN 1200 MeV ELECTRON SYNCHROTRON. See Abstr. 13383

APPARATUS . PARTICLE DETECTORS

539.1.07

13517. STUDIES OF SPARK [PARALLEL-PLATE] COUNTERS. E.Bagge and L.Schmieder.
Atomkernenergie, Vol. 4, No. 5, 169-81 (May, 1959). In German.

Gives details of circuits used for the measurement of spark (plate) counters. Detailed studies of counter performance were made, and the theory of breakdown, etc, is discussed using measured data for Townsend's α coefficient in an appropriate gas mixture.

J.D.Craggs

539.1.07

13518. DETECTION OF FAST NEUTRONS WITH SPARK COUNTERS. G.Krüger.
Nukleonik, Vol. 1, No. 7, 237-41 (Aug., 1959). In German.

In order to study the performance of spark counters as detectors of fast neutrons, a series of different designs was constructed. Two types are described. A ten-wire counter with methane filling had a discriminating power of 5000 between neutrons and γ-quanta. Counter life is limited by physical damage to the wires. These can easily be replaced.

T.Mulvey

539.1.07

13519. ALPHA-PARTICLE SPECTROSCOPY BY SCINTILLATIONS. F.Demichelis.
R.C. Accad. Naz. Lincei, Vol. 26, No. 2, 221-4 (Feb., 1959). In Italian.

Several scintillators were examined in respect of their energy resolution and time resolution properties when exposed to α-particles from Ra^{226}, Th^{228} and Po^{210}. The response was linear with energy of α-particle for CsI:Tl, anthracene, and terphenyl with tetraphenyl butadiene in polystyrene. Oscillograms of the spectra are shown. Energy resolution for the three types of scintillator was 5%, ~ 10%, and up to 19% respectively, while the decay times were 300, 25, and < 7 mμsec.

S.T.Henderson

539.1.07

13520. A MULTI-PURPOSE 2π COUNTER.
D.Prosperi and S.Sciuti.
Nuovo Cimento, Vol. 13, No. 4, 769-77 (Aug. 16, 1959).

A gas counter with a spherical symmetry is described. This detector can work in a very satisfactory manner, either as a flow counter or an ionization chamber reaching, in the latter case, a good α pulse-height resolution, even with large emitting sources. Calculations are made in order to find the dependence of the pulse shape on the direction of emission of an α-particle by a point source in the chamber (finite track). A good agreement is found between these calculations and the experimental tests performed, which shows t this dependence can be employed in high efficiency measurements angular $\alpha-\gamma$ correlations.

539.1.07 : 535.

13521. HIGH-LEVEL DOSIMETRY BY LUMINESCENCE DEGRADATION. F.H.Attix.
Nucleonics, Vol. 17, No. 4, 142-144, 146-148 (April, 1959).

A simple fluorimeter using a photomultiplier is used to measu the fluorescence at 4420 A of $\frac{1}{16}$ in. thick wafers of anthracene and p-quaterphenyl excited with 3650 A u.v. radiation. The luminescre degradation is a measure of the dose within the range 5×10^8 to 5×10^9 rads. The accuracy is about 10% and is unaffected by dos rate.

R.D.Sm

539.1.

13522. THE USE OF DECOLORIZATION PHENOMENA IN HIGH POLYMERS FOR DOSIMETRIC PURPOSES. W.Goebel.
Nukleonik, Vol. 1, No. 6, 227-33 (June, 1959). In German.

Changes in optical and ultraviolet absorption following β-irra tion have been measured in 10 different plastic foils. Diacetate fo (3.94 mg/cm^2; 30 μ) appears to be a suitable dosimeter for radiati doses of the order of 10^7 rad by measuring the relative absorptio 2800 A. The effect is stable for periods up to 5 months after irradiation and reproducibility is claimed to be better than 10%. Calibration curves of log (relative absorption) versus dose are approximately linear.

J.R.Malla

539.1.

13523. AN ABSORBER SYSTEM FOR SCATTERING EXPERIMENTS. W.J.O'Neill, E.Sundahl and H.Ostrander.
Nuclear Instrum., Vol. 4, No. 1, 50-1 (Jan., 1959).

A remotely controlled system for positioning absorbers in th detection system of a large scattering chamber is described.

C.J.Bat

539.1

13524. DETERMINATION OF THE VELOCITY OF IONIZING PARTICLES USING A HIGH-FREQUENCY ELECTRIC FIELD FO TRACK MARKING. G.A.Askar'yan.
Zh. eksper teor Fiz., Vol. 34, No. 4, 1005-7 (April, 1958) In Russian. English translation in: Soviet Physics—JETP (New York), Vol. 34(7), No. 4, 693-5 (Oct., 1958).

An analysis of Gabor and Hampton's scheme (Abstr. 258 of 1958) for determination of velocities of ionizing particles in a clo chamber by radiofrequency field "marking" of the tracks. The modulation of ionic density of a track and the track-marking inter for fast particles are derived, and suggestions for increasing the efficiency of the method are made.

B.Melta

539.1

13525. MEASUREMENT OF THE MULTIPLE SCATTERING OF TRACKS OF PROTONS HAVING ENERGIES OF 6 AND 2 GeV IN NUCLEAR EMULSION. B.Dépaux and Tsai-Chü.
C.R. Acad. Sci. (Paris), Vol. 249, No. 3, 404-6 (July 20, 1959). In French.

By combining the formulae for the tangent and sagitta metho of measuring the curvatures of tracks the effect of background no is eliminated, thereby allowing the multiple scattering to be deter mined. G5 emulsion stacks were used.

J.D.Dow

539.1.07 : 778.

13526. STUDY OF THE LOADING OF SOME NUCLEAR EMULSIONS BY BORON AND LITHIUM. V.Labéu and M.Nikolae
Rev. de Physique (Bucarest), Vol. 4, No. 1, 99-107 (1959). In Russian.

Details are given of the preparation of the plates and of som tests made with them. It is found that relative determinations of neutron currents can be carried out by calculations on tracks wit free path 6-9μ. The number of tracks recorded per unit surface plate may be determined with an accuracy of 2-8%. Using a stand source absolute determinations can be made. Under standard co ditions of temperature and pH it is possible to introduce 10-120 B/cm^3 of emulsion and 3.5-20 mg Li/cm^3 thus permitting quite different orders of neutron current to be handled with these plate

C.R.S.Mand

539.1.07

527. RANDOM FLUCTUATIONS IN PERIOD-METER DICATIONS. M.Grim, Jr., B.B.Barrow and J.C.Simons, Jr. clear Sci. Engng, Vol. 1, No. 1, 80-91 (March, 1956).

Measurement of reactor period at low power levels (from $^{-10}$ to 10^{-5} of full power) during start-up is desirable to permit full power level to be reached rapidly yet safely. At low flux vels, it is natural to attempt to obtain period information by ferentiating the output of a logarithmic counting-rate meter. cause of the random arrival of pulses at the input of the system, wever, the period indicated at the output will fluctuate about the rrect value, the magnitude of the fluctuation depending upon the erage counting rate and upon the system parameters. If the diode the logarithmic circuit is replaced for incremental analysis by an propriate linear resistor, the magnitude of the output fluctuations n be calculated by applying shot noise theory. These calculations e here carried out for the infinite-period case (constant counting e), using the counting rate as an independent variable. Experints were carried out, and the results agreed closely with theory. hough the present study is based on fluctuations occurring when is held constant, other work shows the result to be applicable o to flux transients.

539.1.07

528. A DOUBLE MAGNETIC-LENS SPECTROMETER WITH PROVED FOCUSING FOR THE RECORDING OF COINCIDENCES. A.Sergienko.

r. Akad. Nauk SSSR, Ser. fiz., Vol. 22, No. 2, 198-207 (1958). Russian. English summary: PB 141041T-2, obtainable from ffice of Technical Services, U.S. Dept. of Commerce, Washington, C., U.S.A.

The arrangement, designed to investigate β—e (conversion) and e coincidences, consists of two symmetrically mounted spectroters having a common vacuum chamber, the radioactive source ng inserted into the chamber by a special appliance without disbing the vacuum. The scintillation counter employs a stilbene ystal mounted in vacuo, together with the photomultiplier. This ows the detection of low energy electrons, down to 5 keV. vestigation of the decay chains of ThB, Au^{198}, and Ce^{141}, and of the ncidences between several γ-conversions in the decay of Yb^{169}, owed that the instrument can be used to study: (1) β—e decay ains of relative intensity not below 10^{-3} at a β-spectrum energy nit of 0.5-1 MeV; (2) e—e decay chains of intensity not below 10^{-5}.

I.C.Demetsopoullos

539.1.07

529. A DETECTOR FOR FAST NEUTRONS.

Ball and K.H.Lauterjung.

angew. Phys., Vol. 11, No. 7, 245-7 (July, 1959). In German.

A proton recoil counter for neutrons with energies exceeding MeV is described. The protons are detected by a ZnS screen, ivated with silver. The thickness of the screen for maximum sitivity is shown to be 15 mg/cm^2.

S.J.St-Lorant

539.1.07 : 778.34

USE OF NUCLEAR EMULSIONS FOR NEUTRON SPECTROTERS. See Abstr. 14012.

ELEMENTARY PARTICLES

539.12 : 539.17

530. γ—γ ANGULAR CORRELATION MEASUREMENTS OF ERMAL-NEUTRON CAPTURE γ RAYS IN MAGNESIUM, SILICON, OSPHORUS, AND SULFUR. G.Manning and G.A.Bartholomew.

ys. Rev., Vol. 115, No. 2, 401-11 (July 15, 1959).

Describes an angular correlation apparatus, using two NaI(Tl) ntillation spectrometers, which has been used to study cascades of adiation following thermal-neutron capture. The elements studied re Mg, Si, P and S. The following new spin assignments were made: 4.93 MeV level of Si^{29}, $\frac{3}{2}$; 6.38 MeV level of Si^{29}, $\frac{1}{2}$; 1.15 MeV el of P^{32}, 1; and 3.26 MeV level of P^{32}, 2. In addition, the spins of 3.41 MeV level of Mg^{25} and the 3.22 MeV level of S^{33} were conned to be $\frac{3}{2}$. Other aspects of the decay schemes are discussed.

539.12 : 778.34

MEASUREMENT OF NEUTRON FLUX USING A [LOADED] CLEAR EMULSION PREPARED FROM GEL. e Abstr. 14014.

539.12

13531. CALCULATION OF THE MULTIPLE SCATTERING OF LEAD AND THORIUM GAMMA RAYS.

A.N.Orlov, V.S.Galishev and G.G.Taluts.

Dokl. Akad. Nauk SSSR, Vol. 126, No. 5, 975-8 (June 11, 1959). In Russian.

Results are given for the simplest geometrical conditions. All of the more intense levels of energy $E > 0.5$ MeV were employed in the calculations, which were carried out with the polynomial expansion.

G.E.Brown

539.12

13532. SCATTERING OF 50 TO 150 MeV PHOTONS BY PROTONS AND DEUTERONS.

L.G.Hyman, R.Ely, D.H.Frisch and M.A.Wahlig.

Phys. Rev. Letters, Vol. 3, No. 2, 93-6 (July 15, 1959).

Experimental results obtained by the authors at 90^0 are combined with other results to give the cross-section for protons up to 300 MeV and for deuterons up to 140 MeV. The observed proton scattering is well described by a model of the proton as a Dirac particle with the addition of strong interactions giving the well-known $\frac{3}{2}$, $\frac{3}{2}^+$ and $\frac{1}{2}$, $\frac{3}{2}^-$ resonances of the pion—nucleon system, provided the π^0 lifetime is greater than 10^{-18} sec. The scattering of photons by deuterons below the meson threshold appears to be rather larger than expected.

S.J.Goldsack

539.12

13533. NON-LOCAL THEORY OF THE COMPTON EFFECT.

A.M.Longoni.

Nuovo Cimento, Vol. 13, No. 4, 802-8 (Aug. 16, 1959). In Italian.

The aim of this paper is to apply the non-local theory proposed by Wataghin to the Compton effect and to study the asymptotic behaviour of the differential cross-section by means of this theory.

539.12

13534. ABSORPTION OF 1 BeV PHOTONS. E.Malamud.

Phys. Rev., Vol. 115, No. 3, 687-94 (Aug. 1, 1959).

The total cross-section for the attenuation of high-energy gamma rays was measured in various elements. The variation with atomic number, Z, was observed by measuring the absorption of 1 BeV gamma rays in 12 different elements ranging from hydrogen to uranium. Additional measurements were made in copper at 400 and 700 MeV to show the energy dependence of the absorption processes. These results are then combined with those of other investigators at lower energies and show that the theory of pair production in the nuclear field correctly predicts the cross-section as a function of atomic number and photon energy. The measurements in low-Z elements give information on pair production in the field of the electron. The results are in closer agreement to the calculations of Wheeler and Lamb than to the estimate of Joseph and Rohrlich. In addition a short experiment was performed to measure the symmetry of the energy distribution between the electron and positron members of the pair. The results show that the energy-sharing curve is symmetrical as predicted by theory. See also Abstr. 13545, , 1959).

539.12

13535. A CRITICAL ASSESSMENT OF AN EXPERIMENT DESIGNED BY CLAY—HEREFORD TO MEASURE THE CIRCULAR POLARIZATION OF γ-RAYS BY DETECTION OF COMPTON ELECTRONS. J.Deutsch.

Ann. Soc. Sci. Bruxelles I, Vol. 73, No. 2, 270-8 (1959). In French.

An experiment to determine the polarization of annihilation γ-rays from a positron emitter by production of Compton electrons in magnetized foils is described. The experimental difficulties of saturating the foils magnetically and counting the electrons against a background of the order of 20 times the count rate nullified the attempts.

A.E.I. Research Laboratory

539.12 : 539.18

PHOTOELECTRIC EFFECT FROM POLARIZED PHOTONS. See Abstr. 12732

539.12

13536. BREMSSTRAHLUNG FROM A MAXWELLIAN GAS.

J.Greene.

Astrophys. J., Vol. 130, No. 2, 693-701 (Sept., 1959).

The power radiated from an ionized gas as a result of bremsstrahlung was evaluated numerically. The calculation is based on Berger's evaluation of Sommerfeld's theory, which neglects only relativistic and retardation effects. Some results on the spectra of the radiated energy are also given.

539.12

13537. DETECTION OF COHERENT BREMSSTRAHLUNG FROM CRYSTALS. O.R.Frisch and D.N.Olson.
Phys. Rev. Letters, Vol. 3, No. 3, 141-2 (Aug. 1, 1959).

An experiment has been performed to demonstrate the enhancement of bremsstrahlung from a crystal traversed by a beam of fast electrons, when they are travelling in a direction parallel to a row of atoms. A small germanium crystal was bombarded with 1 BeV electrons from the Cornell synchrotron and scintillation counters were used to detect the resulting X-rays. A coherent beam about 4 milliradians wide was found, in agreement with the expected result. J.D.Dowell

539.12

13538. LIFETIMES OF TRAPPED RADIATION BELT PARTICLES DETERMINED BY COULOMB SCATTERING.
R.C.Wentworth, W.M.MacDonald and S.F.Singer.
Phys. of Fluids, Vol. 2, No. 5, 499-509 (Sept.-Oct., 1959).

Once introduced into captive orbits, protons and electrons should be strictly trapped in the earth's dipole magnetic field. However, various mechanisms exist which limit their lifetimes, such as collisions with atoms and ions in the earth's outer atmosphere, charge exchange, and scattering by hydromagnetic waves. This paper considers only the effect of the scattering of these particles by the ionized hydrogen and electron components of the outer atmosphere. However, the effect of scattering from neutral atoms can be qualitatively taken into account by using the radius of the atom in place of the Debye shielding length in the scattering formulae. The Fokker–Planck equation has been used to derive an expression for the change in the distribution function due to small-angle, single-particle Coulomb collisions. Upper lifetime limits, as determined by this mechanism, of both protons and electrons are derived as functions of their initial energies.

539.12

13539. ELECTROMAGNETIC PROCESSES AT HIGH ENERGIES. I. ANOMALOUS SHOWERS. P.K.Aditya.
Nuovo Cimento, Vol. 13, No. 5, 1013-25 (Sept. 1, 1959).

The problem of anomalous showers is discussed with a view to compare their fluctuations with those for two other samples of electromagnetic cascades. It is concluded that the observed discrepancies result on account of the individuality of the events and that the fluctuations are similar to those for normal cascades. In general the fluctuations are found to be not very much larger than those for a Poisson distribution.

539.12

13540. THE HISTORY OF DOUBLE SCATTERING OF ELECTRONS AND EVIDENCE FOR THE POLARIZATION OF BETA RAYS. L.Grodzins.
Pros. Nat. Acad. Sci. U.S.A., Vol. 45, No. 3, 399-405 (March, 1959).

The experimental test of parity violation involves the observation of anisotropy in longitudinal polarization of electrons emitted from unoriented nuclei. The experimental conditions necessary for the detection of such a longitudunal polarization are given and the more recent results of work in this field are quoted. Earlier workers, Cox (Abstr. 3259 of 1928) and Chase (Abstr. 1096 of 1930, 609-10 of 1931) performed experiments using β-rays from natural sources which could have detected the anisotropy due to non-conservation of parity with decreased efficiency. The result of these experiments is considered by the author to be the first evidence of non-conservation of parity in weak interactions.
A.E.I. Research Laboratory

539.12

13541. MOST PROBABLE ENERGY LOSS OF FAST ELECTRONS. H.E.Hall, A.O.Hanson and D.Jamnik.
Phys. Rev., Vol. 115, No. 3, 633-5 (Aug. 1, 1959).

The most probable energy losses of electrons of 3.4, 7.2, 11.2, 15.6, and 19.4 MeV were measured for Al, Cu, Ag, Ta, Au, and U samples of about 1 g/cm^2. The measurements agree with available calculations and remove the previous discrepancy for gold.

539.12

13542. ON SOME CASES OF ELASTIC SCATTERING OF $\pi^+-\mu^+-e^+$-DECAY POSITRONS ON EMULSION ELECTRONS. Z.V.Minervina and E.A.Pesotskaya.
Zh. eksper. teor. Fiz., Vol. 36, No. 2, 444-6 (1959). In Russian.

$\pi^+-\mu^+-e^+$-decay events involving two electron tracks originating at the end of a μ-meson track are considered. It is suggested that such cases which occur near the $\mu-e$ decay point are due to elastic scattering of positrons on emulsion electrons.

539.12

13543. CALCULATION OF PSEUDO-TRIDENT PROCESSES WITH ESTIMATION OF CROSS-SECTION FOR DIRECT FORMATION OF ELECTRON–POSITRON PAIRS BY ELECTRONS. V.A.Tumanyan, V.A.Zharkov and G.S.Stolyarova.
Dokl. Akad. Nauk SSSR, Vol. 122, No. 2, 208-10 (1958). In Russian.

A Monte Carlo method is used to calculate the number of apparent tridents produced by bremsstrahlung from electrons at 10^{10} to 10^{12} eV, and from this the number of true tridents is deduced from experiment. J.W.G.Wignall

539.12

13544. RECOIL MOMENTUM DISTRIBUTION IN ELECTRON PAIR PRODUCTION. K.S.Suh and H.A.Bethe.
Phys. Rev., Vol. 115, No. 3, 672-7 (Aug. 1, 1959).

Electron pair production by a very energetic photon in the field of a particle of arbitrary mass (in particular in the fields of an electron and a nucleus) is studied following the work of Borsellino [Abstr. 1057 (1948) and Rev. Univ. Nac. Tucuman A, Vol. 6, 7 (1947)]. The distribution of recoil momenta q is calculated for q of order of the electron mass and it is shown that the recoil distribution is independent of the mass of the recoil particle if appropriate variables are used. It is also explicitly shown that the mass of the recoil particle does not make any difference in the recoil distribution for very small q (of order q_{min}). The total cross-section must therefore be independent of the mass of the recoil particle in the high-energy limit, as previously stated by Borsellino. The Wheeler–Lamb result for pair production in the field of a bound electron is also justified. The results also describe the electromagnetic production of any fermion pair if certain restrictions are satisfied.

539.12

13545. ELECTRON PAIR PRODUCTION IN THE FIELD OF THE PROTON AND IN THE FIELD OF THE ELECTRON BY PHOTONS OF ENERGY FROM 10 MeV TO 1 BeV.
E.L.Hart, G.Cocconi, V.T.Cocconi and J.M.Sellen.
Phys. Rev., Vol. 115, No. 3, 678-86 (Aug. 1, 1959).

A 24 in. diffusion cloud chamber filled with hydrogen and located in a magnetic field was placed in the hardened bremsstrahlung beam of the Cornell synchrotron to study electron pair production in the proton field (P.F. pairs) and in the electron field (E.F. pairs). The E.F. pairs could be detected with an average efficiency of ~ 85% and are about as abundant as the P.F. pairs. A total of 3065 pairs produced by photons with energy from 10 to 1040 MeV have been analyse The principal results are: (1) The recoil momentum distribution of the E.F. pairs is in good agreement with the distribution predicted b Suh and Bethe (see preceding abstract); (2) The cross-section for E.F. pairs is consistent with that calculated by Wheeler and Lamb, [Abstr. 2630 of 1939 and Phys. Rev., Vol. 101, 1836 (1956)]; (3) The distribution of the opening angle of P.F. and E.F. pairs is in general agreement with Borsellino's calculations, at large angles. However the peak appears at smaller angles than predicted. See also Abstr. 13534.

539.12

13546. ON AN ESTIMATION OF THE CONTRIBUTION OF NUCLEON–ANTINUCLEON INTERACTION IN THE DISPERSION RELATION FOR NUCLEON–NUCLEON SCATTERING. L.I.Lapidu
Zh. eksper. teor. Fiz., Vol. 36, No. 1, 283-90 (1959). In Russian.

The relation between the scattering lengths and effective radii in the s- and p-states as predicted by the dispersion relations for N–N scattering are discussed. Estimations of the contribution of N–N interaction to the dispersion relations for N–N scattering were derived from the experimental data on n–p and p–p scattering at low energies. The N–N interaction contribution has been found to be small. Its magnitude pronouncedly depends on the sign of the scattering path in the s-states.

539.1

13547. NOTES ON ANTIBARYON INTERACTIONS. A.Pais.
Phys. Rev. Letters, Vol. 3, No. 5, 242-4 (Sept. 1, 1959).

Gives consequences of parity, charge conjugation, charge symmetry, charge independence and time reversal invariances for certain reactions resulting from $\bar{p}$ and $\bar{\Lambda}$ annihilation on protons an on deuterons. J.C.Taylo

539.12

548. PROTON—NEUTRON MASS DIFFERENCE.
Junakawa and K.Tanaka.
ys. Rev., Vol. 115, No. 3, 754-62 (Aug. 1, 1959).
An expression for the electromagnetic self-mass of a physical cleon is obtained from the basic postulates of field theory. A mplete set of intermediate states is then introduced and the one-cleon state and the state with one nucleon plus a nucleon pair are en into account. Direct comparison is thus established between various methods of obtaining the proton—neutron mass difference. e mass difference is computed by two methods which use the nford form factors. It is shown that if the form factor which agrees the experimental region is used in the nonexperimental region in e nucleon-pair term, then there is a disagreement with the present ectromagnetic explanation of the proton—neutron mass difference.

539.12 : 778.34

549. THE METHOD OF "CONSTANT SAGITTA" APPLIED TO ROTONS WITH RESIDUAL RANGE LESS THAN 2000 μ IN MULSION. J.Catala, F.Senent and J.Aguilar.
Particle photography" conference, Strasbourg, 1957 (see ostr. 11704 of 1959) pp. 391-400. In French.
Examines the validity of the constant sagitta method for deter-ining the mass of particles towards the end of their range. The lue of the mean deviation $\bar{D}$ is calculated by noise elimination be-ween a group of basic cells and a group of multiples or submultiples the basic cells. The results are in accord with previous work and standard scheme is suggested as giving the "best" estimate of the ass. S.J.St-Lorant

778.34 : 539.12

METHOD OF "CONSTANT SAGITTA" APPLIED TO PROTONS WITH RESIDUAL RANGE LESS THAN 2000 μ IN EMULSION. See Abstr.13549.

539.12 : 539.14

3550. PROTON—NEUTRON INTERACTION AND THE (p,n) REACTION IN MIRROR NUCLEI.
.D.Bloom, N.K.Glendenning and S.A.Moszkowski.
Phys. Rev. Letters, Vol. 3, No. 2, 98-9 (July 15, 1959).
Shows that the (p,n) reactions which connect the ground states of nirror nuclei give information about the charge-exchange part of he effective n—p potential, i.e. the direct interaction.
R.J.N.Phillips

539.12

3551. ELASTIC SCATTERING AND POLARIZATION OF PROTONS BY HELIUM AT 147 AND 66 MeV.
A.M.Cormack, J.N.Palmieri, N.F.Ramsey and R.Wilson.
Phys. Rev., Vol. 115, No. 3, 599-608 (Aug. 1, 1959).
Measurements were made of the polarization and differential cross-section in elastic p—α scattering at 147 and 66 MeV, in the laboratory angular ranges of 2°-165° and 10°-45°, respectively. These were compared with recent calculations which relate the scattering amplitudes to nucleon—nucleon results. Because these calculations take into account the angular variation of the nucleon—nucleon amplitudes, better agreement is obtained than heretofore. A comparison of the polarization with that observed in inelastic scattering from several levels of a variety of spin-zero nuclei ndicates a strong similarity between the elastic and inelastic data, which can be explained theoretically.

539.12

3552. LOW-ENERGY ANTIPROTON INTERACTIONS IN HYDROGEN AND DEUTERIUM.
.Horwitz, D.Miller, J.Murray and R.Tripp.
Phys. Rev., Vol. 115, No. 2, 472-7 (July 15, 1959).
The distributions of charged particles resulting from antiproton nnihilations in hydrogen and deuterium are compared with the redictions resulting from the "normalized" statistical theory of Fermi. Multiplicities and momentum distributions are shown to be n agreement with the theory if the radius of the interaction volume s chosen to be about 3×10^{-13} cm. The values given for the average multiplicities observed in hydrogen and deuterium are .94 ± 0.31 and 5.03 ± 0.44, respectively, both somewhat lower than ound in the emulsion experiments. K-meson production in annihilations was found to be consistent with previous experiments, but the umber of events is statistically inadequate to warrant any new onclusions. The total elastic scattering cross-sections in hydrogen, though of small statistical significance, are in agreement with ecent theoretical calculations.

539.12

13553. PION—PION CORRELATIONS IN ANTIPROTON ANNIHILATION EVENTS.
G.Goldhaber, W.B.Fowler, S.Goldhaber, T.Hoang, T.E.Kalogeropoulos and W.M.Powell.
Phys. Rev. Letters, Vol. 3, No. 4, 181-3 (Aug. 15, 1959).
Measurements of the distribution of angles between charged pion pairs resulting from antiproton annihilation in a propane bubble chamber are reported. Distributions are given for pion pairs of both equal and opposite charge, and for events in which either four or six charged pions are emitted. Only events in which the number of negative and positive pions was equal were considered. The experimental distributions are compared to those predicted by phase space arguments alone. There are significant discrepancies, particularly for the case of equally charged pairs, which, it is suggested, are due to final state pion—pion interactions.
E.J.Squires

539.12 : 539.17

ABSORPTION OF POLARIZED μ^--MESONS BY NUCLEI. ANGULAR DISTRIBUTION OF THE NEUTRONS. See Abstr. 12688

539.12

13554. ELASTIC NEUTRON—DEUTERON SCATTERING.
R.Blankenbecler, M.L.Goldberger and F.R.Halpern.
Nuclear Phys., Vol. 12, No. 6, 629-46 (Sept. (1), 1959).
The process is discussed from the standpoint of dispersion theory. Aside from the appearance of anomalous thresholds, there seems to be no difficulties in principle, although no derivation of the relations is attempted. Certain features of the process, such as the pick-up peak in the backward direction, appear quite neatly and the general occurrence of such phenomena is discussed. The theory is developed for the general case, but the only application is to forward scattering at low energies where phase shift analyses are available. The agreement with experiment is quite good.

539.12

13555. SCATTERING OF 590 MeV NEUTRONS BY PROTONS IN THE SMALL ANGLE REGION.
B.M.Golovin, V.P.Dzhelepov, Yu.V.Katyshev, A.D.Konin and S.V.Medved'.
Zh. eksper. teor. Fiz., Vol. 36, No. 3, 735-8 (1959). In Russian.
The differential elastic n—p scattering cross-sections for angles from 5° to 35° in the c.m.s. were determined for 590 MeV neutrons by the ring scatterer method. A strong increase of the cross-sections was found with decrease of the scattering angle. Moreover, the "forward" scattering cross-sections were found to exceed the "backward" cross-sections. A comparison of the results obtained with the predictions of the optical theorem shows that it does not seem correct to treat nucleon—nucleon scattering processes at ~ 600 MeV on the basis of the opaque nucleon concept.

539.12

13556. THE ATTENUATION OF NEUTRONS BY AIR DUCTS IN SHIELDS. A.Simon and C.E.Clifford.
Nuclear Sci. Engng, Vol. 1, No. 2, 156-66 (May, 1956).
The attenuation of fast neutrons by long, thin air ducts in shields is considered from a simple phenomenological point of view. It is shown that the wall-scattered flux in a straight duct is small compared with the uncollided neutrons which travel directly in air from one end of the duct to the other. An expression for the attenuation due to a bend is derived and this is generalized to the case of several bends.

539.12

13557. ELECTRIC POLARIZABILITY OF THE NEUTRON.
L.L.Foldy.
Phys. Rev. Letters, Vol. 3, No. 2, 105 (July 15, 1959).
It is shown that the existence of an anomalous moment for the neutron implies an electric polarizability for the neutron $\alpha = -6.2 \times 10^{-44}$ cm^3. Contributions from the meson cloud are discussed. C.J.Batty

539.12

13558. CALCULATION OF POLARIZATION OF MEDIUM-ENERGY NEUTRONS. P.É.Nemirovskii.
Zh. eksper. teor. Fiz., Vol. 36, No. 2, 588-93 (1959). In Russian.
The polarization of 0.1-1 MeV neutrons scattered on heavy nuclei is investigated. It is shown that the polarization can be

described with satisfactory accuracy by introducing in the optical potential an additional term of the form

$$-\frac{\kappa}{r}\frac{dV}{dr}(\sigma l),$$

where $\kappa = 3 \times 10^{-27}$ cm^2. The best agreement between the theory and experiment is obtained when the imaginary part of the potential is 2.5 MeV.

539.12 : 539.17

ABSORPTION OF POLARIZED μ^--MESONS BY NUCLEI, NEUTRON POLARIZATION. See Abstr. 12689

539.12 : 539.17

13559. μ-MESON AND THE CATALYSIS OF NUCLEAR REACTIONS. N.D'Angelo.
Amer. J. Phys., Vol. 27, No. 7, 466-9 (Oct., 1959).

A summary is given of the few experimental and theoretical studies of μ-mesons as catalysers of nuclear reactions between hydrogen isotopes. Present indications are that this is not likely to be practical for the production of power.

539.12

13560. ELECTROMAGNETIC TRANSITIONS BETWEEN μ MESON AND ELECTRON. S.Weinberg and G.Feinberg.
Phys. Rev. Letters, Vol. 3, No. 2, 111-14 (July 15, 1959).

It is pointed out that although the μ-e-γ interaction may not occur for real photons, as indicated by experiments, it may occur for virtual photons. A possible mechanism for this is considered in which the muon and electron interact at a vertex with a muon pair, which then produce the virtual photon. A good test of the interaction is the process,

$$\mu + N \rightarrow e + N'$$

in which the virtual photon interacts with the nucleus, N. The matrix element for this transition is deduced from electron scattering data. It is then found that the maximum rate is obtained for nuclei in the region of copper and that the coherent (N' = N) process predominates. Present experimental evidence (Abstr. 2446 of 1956) shows that the coupling constant for the proposed interaction is rather less than the ordinary Fermi coupling constant. A similar result is obtained from the process $\mu \rightarrow e + (e^+ + e^-)$ (Samios and Lee, to be published). A.Ashmore

539.12 : 539.17

EMISSION OF ELECTRONS IN THE CAPTURE OF μ-MESONS AND THE RANGE OF THE FERMI INTERACTION. See Abstr. 13697

539.12

13561. RADIATIVE MUON CAPTURE. J.Bernstein.
Phys. Rev., Vol. 115, No. 3, 694-705 (Aug. 1, 1959).

The theory of radiative muon capture is developed. The discussion includes both parity conserving and nonconserving effects. The Gell-Mann weak magnetic term and the induced pseudoscalar are included, along with comparable relativistic effects in the nucleons. The theory is applied to light nuclei and especially to the radiative Godfrey reaction $\mu^- + C^{13} \rightarrow \nu + \gamma + B^{13}$. An experiment to detect the induced pseudoscalar directly is proposed.

539.12 : 539.17

PRODUCTION OF π^0-MESONS BY ~9 BeV PROTONS IN NUCLEAR EMULSION. See Abstr. 13665

539.12

13562. THE UNIVERSAL FERMI INTERACTION AND THE CAPTURE OF MUONS IN HYDROGEN.
Chzhou Guan-chzhao and V.Maevskii.
Zh. eksper. teor. Fiz., Vol. 35, No. 6 (12), 1581-2 (Dec., 1958).
In Russian. English translation in: Soviet Physics–JETP (New York), vol.35(8), No. 6, 1106-7 (June, 1959).

Expressions are given for the probability of capture and for the angular distribution and polarization of the emerging neutrons for μ^- capture by protons, based on the assumption of the universal (V-A) interaction with a conserved vector current. E.J.Squires

539.12

13563. THEORY OF COMPOSITE π^0 MESONS. M.E.Perel'man
Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 508-9 (Aug., 1958). In Russian. English translation in: Soviet Physics–JETP (New York) Vol. 35(8), No. 2, 350-1 (Feb., 1959).

The apparent discrepancy in the lifetime of π^0-mesons is suggested to be due to the possible existence of an isotopic spin singlet state ρ^0 in the Fermi–Yang scheme. The ρ^0- and π^0-mesons would participate in strong interactions with conservation of isotopic spin, and the members of the triplet π_1 and π_2 would be involve in electromagnetic and weak interactions. S.J.St-Lorant

539.12

13564. DISPERSION RELATIONS FOR THE ELECTROMAGNETIC FORM FACTOR OF THE π-MESON. I.T.Dyatlov.
Zh. eksper. teor. Fiz., Vol. 36, No. 2, 505-7 (1959). In Russian.

Dispersion relations are deduced for the electromagnetic form factor of a charged π-meson. By considering only the contribution of a state with two π-mesons to the imaginary part, an equation has been obtained which yields the form factor as a function of the $\pi-\pi$ meson scattering phase shift.

539.1

13565. ENERGY DEPENDENCE OF THE ASYMMETRY COEFFICIENT IN $\pi^+ \rightarrow \mu^+ \rightarrow e^+$ DECAYS FOR THE LOW ENERGY PART OF THE POSITRON SPECTRUM.
V.V.Barmin, V.P.Kanavets, B.V.Morozov and I.I.Pershin.
Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 542-4 (Aug., 1958).
In Russian. English translation in: Soviet Physics–JETP (New York), Vol. 35(8), No. 2, 374-6 (Feb., 1959).

The asymmetry coefficients for the various parts of the positr energy spectrum were studied in a propane bubble chamber. S.J.St-Lorant

539.1

13566. ON π-MESON SCATTERING ON DEUTERIUM.
G.M.Vagradov and I.B.Sokolova.
Zh. eksper. teor. Fiz., Vol. 36, No. 3, 948-9 (March, 1959). In Russian.

The small-angle elastic scattering is not in agreement with th impulse approximation (Abstr. 2996 of 1957). The Brueckner multiple-scattering approximation (Abstr. 2206 of 1953 and Abstr. 5857 of 1953) and the variational calculation of Bransden and Moorhouse (Abstr. 6167 of 1958) are in better agreement, but they both assume an infinite nucleon mass M. If one takes the same limit $M \rightarrow \infty$ in the expression for the differential cross-section given by the impulse approximation, the three results become very similar. This is illustrated for an energy of 300 MeV. J.Lascou

539.1

13567. PROTON POLARIZATION IN MULTIPLE PION PRODUCTION AS A CONSEQUENCE OF THE ISOBAR MODEL.
L.F.Landovitz and L.Marshall.
Phys. Rev. Letters, Vol. 3, No. 2, 106-7 (July 15, 1959).

The process $\pi^+ + p \rightarrow \pi + \pi + N$ is considered in the case wher isobar production is assumed to be the dominant inelastic process. For the case where the isobar decay products are emitted in the production plane the polarization of the decay nucleon is calculated and shown to be zero for certain angles. C.J.Bat

539.

13568. ON THE MAGNITUDE OF THE RATIO σ^-/σ^+ NEAR THE π-PHOTOPRODUCTION THRESHOLD.
S.P.Kharlamov, M.I.Adamovich and V.G.Larionova.
Zh. eksper. teor. Fiz., Vol. 36, No. 3, 945-7 (March, 1959). In Russian.

Baldin (Abstr. 6168 of 1958) gave detailed calculations of the Coulomb corrections for

$$\gamma + d \begin{cases} \pi^+ + 2n \\ \pi^- + 2p \end{cases}$$

Taking into account the difference of the thresholds for the two processes, the ratio σ^-/σ^+ is found to be 1.30 ± 0.11 for a photon energy between 160 and 200 MeV. The threshold difference can be quite important for photoproduction on Be^9 for example. J.Lasco

539.12

569. ON THE PROPERTIES OF K-MESONS.
.I.Granovskiĭ.
kl. Akad. Nauk SSSR, Vol. 125, No. 6, 1225-6 (April 21, 1959).
Russian.

The nonlinear theory of Heisenberg (Abstr. 2100 of 1959) is ed with the Lagrangian

$$\bar{\psi}\gamma_\mu\nabla_\mu\psi + \bar{\chi}\gamma_\mu\nabla_\mu\chi + l^2(\bar{\psi}O_n\chi)(\bar{\chi}O_n\psi).$$

field is constructed which gives particles of spin zero and posi- e parity whose mass (relative to the mass of the proton) is within of the experimental value for the K-meson. This is for O_n in the nlinear term scalar: by taking O_n pseudoscalar and reversing the gn of the nonlinear term, slightly heavier pseudoscalar particles e obtained. G.P.McCauley

539.12

570. POSSIBLE TEST OF CONSERVATION OF PARITY IN RODUCTION OF K-MESONS AND HYPERONS. V.G.Soloviev.
iovo Cimento, Vol. 13, No. 2, 442-3 (July 16, 1959).

This letter was received by the journal in March 1958, but blication was accidentally delayed. It discusses the observable nsequences of possible violation of parity conservation in the rong interactions producing K and Λ or Σ mesons from π—nucleon llisions on the asymmetry in the subsequent Λ or Σ π-decay.
E.J.Squires

539.12

571. DIRECT PROOF OF θ_1^0 NEUTRAL DECAY.
L.Brown, H.C.Bryant, R.A.Burnstein, R.W.Hartung, D.A.Glasser, A.Kadyk, D.Sinclair, G.H.Trilling, J.C.Vander Velde and D.van Putten.
ys. Rev. Letters, Vol. 3, No. 1, 51-2 (July 1, 1959).

Nine photographs have been obtained with a liquid xenon bubble amber in which a Λ^0 decay is accompanied by four γ-ray con- ersion electron cascades; these are interpreted as due to the decay π^0-mesons produced in the process $\theta_1^0 \rightarrow \pi^0 + \pi^0$.
S.J.Goldsack

539.12

3572. REMARKS ON THE DECAY INTERACTIONS IN THE K_{e3} PROCESS. M.Yonezawa.
Nuclear Phys., Vol. 12, No. 6, 589-95 (Sept. (1), 1959).

The following two points are discussed. (a) The possibility of Konopinski—Uhlenbeck type interaction (rather than a Fermi-type nteraction) is examined. It is shown that there exists a certain quivalence theorem between a Fermi-type interaction and Konopinski—Uhlenbeck type interaction and that owing to this theorem t is possible to discriminate between them. (b) The present experi- nental data concerning the secondary electron energy spectrum n K_{e3}^+ are analysed from the standpoint of primary weak Fermi nteraction in order to discuss the type of decay interaction. It is uggested that the existence of scalar and tensor interactions is ecessary to explain the experimental K_{e3}^+ electron energy spectrum, hile the vector interaction gives a fit with χ^2-probability $< \sim 0.07$.

539.12

3573. INVESTIGATION OF K_{e3}-DECAY WITH THE EMISSION OF A GAMMA PHOTON. I.M.Dremin.
Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 515-17 (Aug., 1958). In Russian. English translation in: Soviet Physics—JETP (New York), Vol. 35(8), No. 2, 355-7 (Feb., 1959).

The most general interaction Lagrangian for the process

$$K^0 \rightarrow \pi^\pm + e^\pm + \nu + \gamma$$

s set up and some of its implications discussed, in particular the probability of the decay, the dependence on the energy of the decay pion, and the consequences of parity non-conservation.
S.J.St-Lorant

539.12

3574. PARITIES OF K—HYPERON PAIRS. R.H.Capps.
hys. Rev., Vol. 115, No. 3, 736-41 (Aug. 1, 1959).

The possibility of determining the relative parity of K—hyperon airs by measurements of reactions of the type π (or K) + p → K (or π) + yperon is investigated. If the protons are polarized in a direction erpendicular to the incident meson beam, it is shown that measure- ents of the correlation between the proton spin direction and the irection of the meson from the hyperon decay are capable of deter- mining the parity unambiguously, provided that the K spin is zero and the hyperon spin is known. Several alternate parity-determining experiments that do not require polarized proton targets are discussed; these experiments are all quite difficult, however.

539.12

13575. THE INTERACTION AND DECAY OF K^- MESONS IN PHOTOGRAPHIC EMULSION. I. GENERAL CHARACTERISTICS OF K^--INTERACTIONS AND ANALYSIS OF EVENTS IN WHICH A CHARGED π-MESON IS EMITTED. B.Bhowmik, D.Evans, D.Falla, F.Hassan, A.A.Kamal, K.K.Nacpaul, D.J.Prowse, M.Rene, G.Alexander, R.H.W.Johnston, C.O'Ceallaigh, D.Keefe, E.H.S.Burhop, D.H.Davis, R.C.Kumar, W.B Lasich, M.A.Shaukat, F.R.Stannard, G.Bacchella, A.Bonetti, C.Dilworth, G.Occhialini, L.Scarsi, M.Grilli, L.Guerriero, L.von Lindern, M.Merlin and A.Salandin. (K-collaboration).
Nuovo Cimento, Vol. 13, No. 4, 690-729 (Aug. 16, 1959).

A total of 3480 K^--mesons has been observed. Of these 445 interact in flight, at a mean energy of 40 MeV and only their general characteristics have been studied. Little difference has been observed between the number of unstable charged particles ($\Sigma^\pm$ hyperons and $\pi^\pm$ mesons) in these interactions and those in the 3035 interactions at rest. The 3035 K^- interactions at rest have been studied in detail. In this paper (Pt I) are given the results on those interactions in which π-mesons are emitted. An estimate of the Σ-hyperon nuclear potential is based on the energy spectrum of π-mesons emitted in the K^- interactions in which the only charged particles emitted are a π-meson and a Σ-hyperon. A detailed examination of the angular distribution of 2-pronged events, and of the sign ratio of the π-mesons, the prong distribution and energy release in all events has led to an estimate of the probabilities of absorption of positive and negative Σ-hyperons in the parent nucleus, and to a partition of the events between the various primary reactions.

539.12

13576. ANALYSIS OF THE CHARGE EXCHANGE REACTION $K^+ + p \rightarrow K^0 + n$. C.Ceolin, N.Dallaporta, L.Guerriero, I.Laboragine, G.A.Salandin and L.Taffara.
Nuovo Cimento, Vol. 13, No. 4, 818-38 (Aug. 16, 1959).

A detailed analysis of the data concerning the reaction $K^+ + p \rightarrow K^0 + n$ has been undertaken in order to deduce the behaviour with energy of the total cross-section and the angular distribution of the differential cross-section. It is found that the best fit for the data, corrected for all effects in nuclei, indicate that the total charge-exchange cross-section increases with about the third power of the c.m. momentum. An analysis of the secondary prongs of the K—nucleus events leading to charge-exchange gives indications that the differential cross-section is peaked backward in the c.m. system. These data do not seem to fit with the theoretical formulae based on a KKπ-interaction. Further, different theoretical interpretations are discussed with the aim of seeing if they are adequate to explain the preceding behaviour of the charge-exchange reaction.

539.12

13577. PRODUCTION OF STRANGE PARTICLES IN p—p COLLISIONS AT 3 BeV. V.S.Barashenkov and V.M.Mal'tsev.
Zh. eksper. teor. Fiz., Vol. 36, No. 3, 933-4 (March, 1959). In Russian.

Arguments are presented that the K^+-production cross-section should be $\sigma^+ = 1.0$ mb, rather than the value 0.33 mb, obtained by integrating over an assumed isotropic angular distribution.
J.Lascoux

539.12 : 530.145

ISOTOPIC INVARIANCE IN ANTIHYPERON PROCESSES.
See Abstr. 13022

539.12

13578. PHENOMENOLOGICAL ANALYSIS OF HYPERON DECAY. S.A.Bludman.
Phys. Rev., Vol. 115, No. 2, 468-71 (July 15, 1959).

The $\Delta I = \frac{1}{2}$ rule is incorporated into a previously discussed universal weak Yukawa interaction (Abstr. 7686 of 1958) by assuming the simplest relation between chirality and charge operators. Expressing the $\Delta I = \frac{1}{2}$ rule by forming the N and Ξ isospinors into an isovector B and an isoscalar B_0, it is assumed B occurs (as in β decay) with $g\gamma_\mu\frac{1}{2}(1 + r\gamma_5)$ and B_0 (which has no β-decay counterpart) with $g\gamma_\mu\frac{1}{2}(1 - r\gamma_5)$. Here g is the constant previously fitted to the π decay rate, and r the ratio of Gamow—Teller and Fermi coupling

constants. Depending on the sign taken between the B and B_0 interaction terms, Σ decays into $n + \pi^+$ in pure S and into $n + \pi^-$ in pure P channels, or vice versa. In either case, $\Sigma^+ \rightarrow p + \pi^0$ involves maximal S-P interference and $\alpha^0 = 0.98$. Decay into $I = \frac{1}{2}$ proceeds via $p_{1/2}(\frac{1}{2}s_{1/2} + \frac{3}{2}s_{1/2})$ or $p_{1/2}(\frac{3}{2}s_{1/2} + \frac{1}{2}s_{1/2})$, depending on whether Σ^- decay in pure S or pure P. The second case, but not the first, leads to a Λ-decay rate in agreement with experiment. In this case $\alpha_\Lambda = 0.54$, and in Σ^- decay, $\alpha_\Sigma = 0.64$ and the calculated decay rate is 2.4×10^{-10} sec^{-1}.

539.12

13579. HYPERON BETA DECAY. C.H.Albright.
Phys. Rev., Vol. 115, No. 3, 750-1 (Aug. 1, 1959).

The complete electron spectrum is presented for polarized hyperons undergoing beta decay. Despite the rarity of such events, the availability of polarized hyperons and the favourably large energy release make an experimental analysis of these decays feasible. The basic couplings are assumed to be vector and axial vector, but the new terms which arise from couplings "induced" by the strong interactions are also included.

539.12

13580. SEARCH FOR LEPTONIC DECAYS OF THE SIGMA.
J.Leitner, P.Nordin,Jr, A.H.Rosenfeld, F.T.Solmitz and R.D.Tripp.
Phys. Rev. Letters, Vol. 3, No. 4, 186-8 (Aug. 15, 1959).

A study of 750 Σ^- and 250 Σ^+ decays in a liquid hydrogen bubble chamber has shown that the maximum branching ratio for leptonic decay modes is a few tenths of one percent. This is an order of magnitude smaller than predictions on the basis of a simple extension of the Fermi universal interaction.

S.J.Goldsack

539.12

13581. PRODUCTION OF Σ^+ HYPERONS BY 990-MeV POSITIVE PIONS IN LIQUID HYDROGEN.
A.R.Erwin,Jr, J.K.Kopp and A.M.Shapiro.
Phys. Rev., Vol. 115, No. 3, 669-72 (Aug. 1, 1959).

The production and subsequent decay of six Σ^+ hyperons was observed in the central region of a hydrogen bubble chamber exposed to π^+ mesons of kinetic energy 990 ± 30 MeV at the Cosmotron. The corresponding production cross-section, corrected for scanning inefficiencies, $0.16_{-0.06}^{+0.06}$ mb. This value, combined with weighted averages of Σ^0 and Σ^- production cross-sections in hydrogen obtained by Brookhaven, Columbia and Berkeley groups, is used to compute the three triangular inequalities imposed by charge independence. The inequality

$$[\sigma(\Sigma^+)]^{1/2} + [\sigma(\Sigma^-)]^{1/2} - [2\sigma(\Sigma^0)]^{1/2} = 0.12_{-0.10}^{+0.11}\,(\mathrm{mb})^{1/2} \geq 0$$

is the only one that might not be satisfied. The near-zero value of the left-hand side indicates the difficulty to be encountered in demonstrating a failure of charge independence at this energy.

539.12

13582. PHENOMENOLOGICAL TWO-NUCLEON POTENTIALS AND THE DEUTERON. II. K.V.Laurikainen and O.Varho.
Nuclear Phys., Vol. 12, No. 6, 606-11 (Sept. (1), 1959).

For Pt I, see Abstr. 4279 (1959). The ground state of the deuteron corresponding to Gammel and Thaler's potential has been investigated by numerical integration. There exists no exact ground state in the neighbourhood of the right binding energy. An approximate ground-state wave-function has been tabulated and the corresponding electromagnetic properties of the deuteron have been studied, including the correction to the magnetic moment due to the LS-potential.

539.12

13583. PREDICTION OF DEUTERON POLARIZATION FROM d–α SCATTERING. R.J.N.Phillips.
Phys. Rev. Letters, Vol. 3, No. 2, 101-2 (July 15, 1959).

It is shown that d–α scattering can be useful producer of deuteron polarization in the interval between the resonances at 1.07 and 4.6 MeV (deuteron lab. energy). C.J.Batty

539.12

13584. ON THE INTERPRETATION OF α–α SCATTERING. H.Wittern.
Naturwissenschaften, Vol. 46, No. 14, 443-4 (1959). In German.

An angular-momentum dependent square-well potential for the α–α interaction is deduced from the shell model wave-functions and energy levels of the virtual states of Be^8. By choosing the range of this potential suitably, good agreement with the experimental J = 0, 2, 4 phase shifts for α–α scattering up to 12 MeV is obtained.

E.J.Squire

NUCLEUS

539.14

13585. TWO BODY FORCES IN LIGHT DEFORMED NUCLEI.
D.M.Brink and A.K.Kerman.
Nuclear Phys., Vol. 12, No. 4, 314-26 (Aug. (1), 1959).

There is evidence that the light nuclei in the aluminium region have rotational states. It is well known from studies of heavy rotating nuclei that an independent particle model for a deformed well as used by Nilsson is a surprisingly good approximation for many of the properties of these collective states. However, it has been clear for some time that two body correlations are important for a more complete understanding of the situation. Because the number of single particle states for the light nuclei is relatively small and because isobaric spin is a good quantum number, some studies are here undertaken on the effect of two body forces on binding energies and energy levels. In particular, the method of Bache and Goudsmit (Abstr. 307 of 1935) to find relations among binding energies which depend only upon the existence of two-body forces a the assumption that the deformed wave-function coupling scheme is good first approximation. The relations so obtained are remarkabl well fulfilled by the data while corresponding relations obtained for the spherical shell model are not. Some of the possible excited states in these nuclei are also discussed and estimates made of the energies.

539.1

13586. INVESTIGATION OF THE AVERAGE NUCLEAR POTENTIAL PARAMETERS. L.A.Sliv and B.A.Volchok.
Zh. eksper. teor. Fiz., Vol. 36, No. 2, 539-53 (1959). In Russian.

The parameters of the average nuclear potential have been found on basis of data pertaining to the levels of nuclei with a number of nucleons equal to that of a doubly closed shell plus or minus one nucleon. Results of the calculations are presented. It i shown that the potential parameters are the same for all nuclei lying on the nuclear stability curve. A formula has been derived for the depth of the potential for prescribed values of N and Z. Expansion of the nucleon functions in terms of spherical oscillator functions is considered.

539.

13587. RADIAL DEPENDENCE OF IMAGINARY PART OF NUCLEAR OPTICAL POTENTIAL [FOR NEUTRONS].
K.Harada and N.Oda.
Progr. theor. Phys., Vol. 21, No. 2, 260-8 (Feb., 1959).

The imaginary part is calculated by means of the method of the volume direct processes, on the basis of the statistical independent particle model with a diffuse nuclear surface. It is shown that the localization of the absorption near the surface, whi was found by Bjorklund and Fernbach, can be reproduced using reasonable values for the relevant parameters. The effect of the Pauli exclusion principle, of the energy dependence of the two-bod collision cross-section, of the mass number dependence of the parameters, and of the correlation between nucleons are also discussed.

539

13588. DISTRIBUTION OF THE IMAGINARY PART OF THE OPTICAL POTENTIAL. K.Kikuchi.
Nuclear Phys., Vol. 12, No. 4, 305-8 (Aug. (1), 1959).

The radial dependence of the imaginary part of the nuclear optical potential is calculated by the semi-classical independent particle model with a diffuse nuclear boundary. The present met is completely the same as the one proposed by Harada and Oda (see preceding abstract), whose results are extended for various energies in this work. It is found that the strong absorption at th nuclear surface is less important for intermediate incident energies.

539.14 : 539.17

589. ON THE IMAGINARY OPTICAL POTENTIAL.
H.Lemmer, T.A.J.Maris and Y.C.Tang.
clear Phys., Vol. 12, No. 6, 619-24 (Sept. (1), 1959).
The imaginary part of the nuclear optical potential for nucleons investigated in a semi-quantitative way. For simplicity, harmonic cillator wave-functions have been used to perform calculations O^{16} and Ca^{40}. Results indicate that surface absorption is quite portant for incident energies up to about 60 MeV.

539.14

590. THE STATISTICAL THEORY OF A NUCLEON GAS AT RBITRARY TEMPERATURE. P.Gombás and D.Kisdi.
Phys., Vol. 156, No. 2, 125-30 (1959). In German.
The statistical theory of nuclei is developed and equations lating the density to the nuclear forces, which are assumed to be ntral forces with a general exchange mixture, are derived.
E.J.Squires

539.14

591. ON SYMPLECTIC INVARIANCE OF THE ENERGY ATRIX IN A NUCLEAR j^N CONFIGURATION. K.Helmers.
uclear Phys., Vol. 12, No. 6, 647-56 (Sept. (1), 1959).
The energy matrix of a nuclear j^N configuration of maximum obaric spin is given a convenient form by methods of field theory, d its invariance under the symplectic transformations of Flowers d Edmonds (1952) is investigated. A δ-interaction of arbitrary exange type is shown to lead to an energy matrix that is non-invarit in this sense.

539.14

3592. CONDITIONS OF SUPERFLUIDITY OF AN ATOMIC UCLEUS AND THE PHASE TRANSITION TEMPERATURE.
.G.Solov'ev.
h. eksper. teor. Fiz., Vol. 36, No. 1, 293-4 (1959). In Russian.
The conditions for the appearance of a superfluid state are erived with help of a variational principle proposed by Bogolyubov 958). The conditions reduce to the requirement of predominance attractive forces betweens protons located in the same shell at n energy equal to the Fermi energy. If at zero temperature, the ucleus is in a superfluid state, a transition from the superfluid to ormal phase will take place with increase of the temperature. The ritical temperature of the transition has been determined.

539.14 : 539.12

PROTON–NEUTRON INTERACTION AND THE (p,n) REACTION MIRROR NUCLEI. See Abstr. 13550

539.14

3593. ELECTROMAGNETIC RADII OF THE LIGHTEST NUCLEI THE GROUND AND LOWEST EXCITED STATES.
K.Kaminskii and Yu.M.Shirokov.
n. eksper. teor. Fiz, Vol. 36, No. 3, 874-8 (1959). In Russian.
The radii of nuclei with mass numbers 5-8 are calculated for the round and excited states from experimental data on isotopic multiets and on the scattering of high energy electrons on nuclei. It is nown that, excluding the He^5–Li^5 doublet, the radii monotonously crease with the energy for all nuclei. One of the levels of Be^5 is entified with greater precision.

539.14

3594. MEASUREMENT OF THE MASS OF Rn^{222} BY MASS PECTROGRAPHY. S.Szücs and J.M.Delfosse.
nn. Soc. Sci. Bruxelles I, Vol. 73, No. 2, 279-86 (1959). In French.
The doublet Rn^{222}–$Pb^{207}(CH_3)$ was measured with an Ilford Q_1 late, and a mass of 222.0865 ± 0.0007 was found for Rn^{222}. The ass defect relative to $Pb^{206} + 4He^4$ is 30.8 ± 0.7 MeV.
R.Schnurmann

539.14

3595. MASSES OF THE ISOTOPES Th^{232}, U^{234}, U^{235} AND U^{238}.
.A.Demirkhanov, T.I.Gutkin and V.V.Dorokhov.
okl. Akad. Nauk SSSR, Vol. 124, No. 2, 301-3 (1959). In Russian.
Using previously determined values of the masses of C^{12}, C^{13} and ^{14} (Abstr. 9839/1957) the masses of heavy atoms are found by measring the separation of mass spectrographic doublets consisting of he heavy atom and a suitable organic compound. For instance U^{238} compared with both $C_{10}^{12}H_{10}$ and $C_{10}^{12}C^{13}H_8$. The values obtained for he four isotopes are 232.111868 ± 230, 234.115492 ± 84, 235.118841 ± ± 59 and 238.127284 ± 35 respectively. Tables giving the results of other workers are included.
G.P.McCauley

539.14

13596. SPECTROSCOPIC DETERMINATION OF NUCLEAR SPIN IN Lu^{176}. N.I.Kaliteevskii and M.P.Chaika.
Dokl. Akad. Nauk SSSR, Vol. 126, No. 1, 57-8 (May 1, 1959).
In Russian.
The nuclear spin was determined from the relative intensity of the components of hyperfine structure of the line Lu II, λ 6463 A ($^3P_0$ - $^3D_1$), using a photoelectric spectrometer with a Fabry–Perot interferometer. The experimental result agrees well with the value calculated for I = 7.
F.Lachman

539.14

13597. NUCLEAR SPINS OF SILVER-104 AND SILVER-106.
W.B.Ewbank, L.L.Marino, W.A.Nierenberg, H.A.Shugart and H B.Silsbee.
Phys. Rev., Vol. 115, No. 3, 614-18 (Aug. 1, 1959).
The nuclear spins of four neutron-deficient isotopes of silver were measured by atomic-beam methods. The results are: for 27 min Ag^{104}, I = 2; for 1.2 hr Ag^{104}, I = 5; for 24 min Ag^{106}; I = 1; and for 8.3 day Ag^{106}, I = 6. Of these, the result for 1.2 hr Ag^{104} has not been reported previously.

539.14

13598. MAGNETIC MOMENT OF HOLMIUM. V.B.Belyanin.
Optika i Spektrosk., Vol. 5, No. 3, 340-1 (1958). In Russian.
Summary: PB 141047T-7, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.
For the determination of this moment the author makes use of the Fermi–Segré–Goudsmit formula

$$a_S = C \cdot Z \cdot [Z_a^2 (dn_a/dn)/n_a^3] \cdot (\mu/I).$$

The magnitudes C (first factor) and the third factor are approximates from the known values for other rare-earth elements, while the magnitude a_S is determined on the basis of certain assumptions which yield fairly good values for Nd and Pr. The magnetic moment of Ho is thus found to be 3.7 ± 20% nuclear magnetons (positive sign).
F.Lachman

539.14

13599. SPIN–ORBIT CONTRIBUTIONS TO THE H^3-He^3 MAGNETIC MOMENTS. J.M.Berger.
Phys. Rev., Vol. 115, No. 2, 384-8 (July 15, 1959).
The contributions to the magnetic moments of the triton and He^3 from the Signell–Marshak and Gammel–Thaler phenomenological spin–orbit potentials were calculated using the Pease and Feshbach wave-functions. The results indicate that the isotopic spin dependence of the spin–orbit potential should be of the form $(3 + \tau_i \cdot \tau_j)$ and also that the spin–orbit potential contributions are too small by an order of magnitude to account for the approximately 0.2 n.m. anomalies in the H^3–He^3 magnetic moments.

539.14 : 539.17 : 539.18

13600. RATIOS OF RELATIVE ABUNDANCE, MAGNETIC MOMENTS, AND CAPTURE CROSS SECTIONS OF GADOLINIUM ISOTOPES FROM PARAMAGNETIC RESONANCE SPECTRUM.
W.Low and D.Shaltiel.
Phys. Rev., Vol. 115, No. 2, 424-6 (July 15, 1959).
Precision measurements on the hyperfine structure of the transitions corresponding to ΔM = 4 of the cubic-field paramagnetic resonance spectrum of gadolinium in single crystals of thorium oxide, yield the following values: isotopic abundance: even isotopes, 69.45%; Gd^{155}, 15.05 ± 0.2%; Gd^{157}, 15.5 ± 0.2%. Ratio of magnetic moments: $\mu^{155}/\mu^{157} = 0.7495 \pm 0.0045$. Irradiation of crystals at the Harwell pile with a thermal neutron flux of 1.2×10^{12} n/cm^2 sec, and a fast flux of 2.3×10^{11} n/cm^2 sec, yields the ratio of nuclear capture cross-sections $\sigma^{157}/\sigma^{155} = 2.82$, using the above abundance values. No f-centre spectrum was detected in crystals irradiated with a total neutron flux of about 10^{18} n/cm^2. The paramagnetic resonance spectrum of gadolinium in irradiated crystals is unchanged, indicating negligible radiation damage in the neighbourhood of the paramagnetic ions.

539.14

13601. MAGNETIC MOMENTS OF STRONGLY DEFORMED ODD–ODD NUCLEI. W.M.Hooke.
Phys. Rev., Vol. 115, No. 2, 453-6 (July 15, 1959).

The strong-coupling magnetic moment relation is evaluated with the use of Nilsson wave-functions for finite values of core distortion. The theoretical predictions are compared with all of the data available on odd–odd nuclei in the strong-coupling region. There is no evidence for appreciable error having been introduced by the assumption of no interaction between the odd proton and odd neutron.

539.14

13602. QUADRUPOLE MOMENTS OF ODD-NEUTRON NUCLEI. H.Nagai and H.Narumi.
Bull. Kyushu Inst. Technol. (Math. nat. Sci.), No. 5, 23-8 (May, 1959).

Neglecting the effect of configuration mixing, a calculation of electric quadrupole moments of odd-neutron nuclei is made on the basis of the single configuration model. The quadrupole moments of odd-neutron nuclei are assumed to be due to the promotion of two protons from the zeroth-order proton state of seniority zero to the states of seniority two. These mixing coefficients of the ground state are determined by fitting the wave function to the magnetic moment of the odd-neutron nucleus considered. There is fairly good agreement between the calculated and observed values except for nuclei with very large quadrupole moments.

539.14

13603. QUADRUPOLE MOMENT OF THE SECOND EXCITED STATE OF ^{19}F. K.Sugimoto, A.Mizobuchi and H.Yamamoto.
J. Phys. Soc. Japan, Vol. 13, No. 12, 1548 (Dec., 1959).

The angular distribution of the 200 keV γ-rays following the reaction $F^{19}(p,p')F^{19*}$ in polytetrafluorethylene was measured, as a function of the delay time. From the curve, a value of 0.1×10^{-24} cm^2 for the quadrupole moment of the second excited state of F^{19} was deduced.
E.J.Squires

539.14

13604. POLARIZATION OF Au^{196} NUCLEI IN A GOLD–IRON ALLOY. B.N.Samoilov, V.V.Sklyarevskii and E.P.Stepanov.
Zh. eksper. teor. Fiz., Vol. 36, No. 2, 644 (1959). In Russian.

Reports the production of partial polarization of gold nuclei in a gold–iron alloy at very low temperatures. The polarization was detected from the anisotropy of the gamma-ray angular distribution.
J.W.G.Wignall

539.14

13605. THEORY OF THE 0^+ STATES OF O^{16}. I. H.Nagai and Y.Yamaji.
Bull. Kyushu Inst. Technol. (Math. nat. Sci.), No. 3, 15-29 (March, 1957).

Assuming that forces acting on all nucleons in O^{16} are two-nucleon central interactions with the Rosenfeld exchange character, the excitation energy of the excited 0^+ states of O^{16} is calculated on the harmonic-oscillator individual particle model. The authors take into account not only the configurations arising from the excitation of two 1p-nucleons to the 2s-1d shell, but also the configurations arising from the excitation of the first excited 0^+ state is 11.48 MeV about twice the experimental value. The mixture of configurations contains a total of 81% of configurations arising from one-nucleon excitation and, particularly, a total of 79% of the configuration arising from one 1p-nucleon excitation into the 2p shell. Then, a value of 7.5×10^{-26} cm^2 is found for the matrix element of the electric monopole operator $\Sigma_p r_p^2$. The range of harmonic oscillator wave-functions was chosen to give an equivalent r.m.s. radius of the nucleus of $R = r_0 A^{1/3}$. $r_0 = 1.3 \times 10^{-13}$ cm.

539.14

13606. THEORY OF THE 0^+ STATES OF O^{16}. II. H.Nagai.
Bull. Kyushu Inst. Technol. (Math. nat. Sci.),(March, 1958).

Using the energy matrices which were calculated in the previous paper (see preceding abstract) and taking into account two low-lying states, belonging to the $(1s)^4(1p)^{10}(1d)^2$ configuration, of those seven states which were omitted in the previous estimation, more detailed numerical calculations are carried out for the energy of the first excited 0^+ state and the matrix element of the electric monopole transition between this state and the ground state in O^{16}. Contrary to expectation there was very little improvement on the numerical results for above two quantities. A value of 1.25×10^{-13} cm is taken instead of the previous value 1.3×10^{-13} cm for the parameter r_0 of the nuclear radius, $R = r_0 A^{1/3}$. The calculated energy of the first excited state rises up to 14.81 MeV as was expected, but the contribution of the two-nucleon excitation configuration to the first excited state increases by about 10% and then becomes 29%. Consequently a smaller value of 6.4×10^{-28} cm^2 for the matrix element of the electric monopole operator than that in the previous estimation. By introducing an additional assumption it is shown that the calculated first excited level at the position is in good agreement with experiment, but the matrix element is too small by about a factor of three.

539.1

13607. EVIDENCE FOR SHELL-MODEL STATES IN Sc^{41}. C.M.Class, R.H.Davis and J.H.Johnson.
Phys. Rev. Letters, Vol. 3, No. 1, 41-3 (July 1, 1959).

A preliminary account is given of a p-Ca^{40} elastic scattering experiment with protons of energies from 1.2 to 5.5 MeV, and good energy resolution. The shapes of the resonances were analysed by applying dispersion theory, and many l and j values were assigned to the corresponding levels of Sc^{41}. Apart from many levels with small reduced widths, which it is assumed are due to excitation of the core, several of the expected single particle levels, with much larger reduced widths, were identified.
E.J.Squi

539.1

13608. SHELL EFFECTS AT HIGH EXCITATION ENERGIES. H.W.Newson and M.M.Duncan.
Phys. Rev. Letters. Vol. 3, No. 1, 45-6 (July 1, 1959).

A simple model, involving the excitation of pairs of like nucleons in relative 0^+ states, within a shell model scheme, is use to calculate the level densities as obtained from S-wave neutron resonances, as a function of mass number. Curves are obtained for even–even and odd–odd nuclei and the general features are we represented by the model. In particular, peaks in the level spacin corresponding to magic numbers of neutrons or protons in the compound nucleus, are predicted in agreement with experiment.
E J.Squir

539.

13609. NUCLEAR SPECTROSCOPY. I.Perlman.
Proc. Nat. Acad. Sci. U.S.A., Vol. 45, No. 4, 461-71 (April, 1959).

This review article discusses the low-lying states of heavy nuclei and the application of the Nilsson model to these states and their decay properties.
L.L.Gre

539.

13610. THE DEVIATION OF THE EQUILIBRIUM SHAPE OF ATOMIC NUCLEI FROM AXIAL SYMMETRY. D.A.Zaikin.
Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 529-30 (Aug., 1958). In Russian. English translation in: Soviet Physics–JETP (New York), Vol. 35(8), No. 2, 365-6 (Feb., 1959).

To account for the observed asymmetry of certain nuclei an ellipsoidal potential well is postulated, having semi-axes $a_x R_0$, $a_y R_0$ and $a_z R_0$, where R_0 is the radius of the sphere of equal volu For small departures from sphericity, the wave-equation of a nuc leon in the ellipsoidal potential may be solved by perturbation theory. It is found that, for $(1s)^2(1p)^3$ and higher configurations, the energetically most favoured nuclear shape is indeed an ellipso of the kind postulated.
J.W.Gardn

539.14 : 539.1

13611. THE APPLICATION OF THE ANGULAR CORRELATION METHOD TO THE EXPERIMENTAL INVESTIGATION OF LEVEL IN SEVERAL LIGHT NUCLEI. A.Gallmann.
Ann. Phys. (Paris), Ser. 13, Vol. 4, No. 1-2, 185-238 (Jan.-Feb., 1959). In French.

Double and triple angular correlations are treated theoretical and the apparatus and circuitry used to measure several angular correlations are described. (p,γ) correlations in the reaction $B^{10}(d,p)B^{11}$ were measured and the results are discussed. Measur ment of the correlation cascade gammas via the 6.23 MeV level in N^{14} indicates that this state has $J = 1^+$ or 2^+. In the former case the state could be de-excited by almost pure dipolar or quadrupol radiation, but in the second case only almost pure dipolar radiatic would fit the observed (γ,γ) angular correlation. The angular distribution of γ-rays from the 8.34 MeV state of O^{18} to the ground state establishes a value of $J = 3/2$ for the excited state. Angular correlation measurements in, and perpendicular to, the plane of t

dent beam of cascade gammas from the 8.34 MeV state to the und state via a 5.27 MeV state indicate a value of J = 3/2⁻ for intermediate state. A.E.I. Research Laboratory

539.14

2. SPIN AND PARITY OF THE 4.62 MeV LEVEL IN Si^{28}.
mons.
ment. phys.-math. (Helsinki), Vol. 24, No. 2, 10 pp. (1959).
Attempts were made on the basis of the experimental material ently available to resolve between the possibilities of the MeV level in Si^{28} having the spin values 2^+ or 1^+ both of which o now agree with the experimental results. The value 2+ seems e probable. It is sufficient to determine whether a certain tion W(Θ) is falling or rising. Such an experimental investigation ld give crucial evidence.

539.14

3. CHARACTERISTICS OF EXCITED STATES FORMED BY E CAPTURE OF INTERMEDIATE ENERGY NEUTRONS IN NGSTEN AND PLATINUM.
orge, Vinh-Dinh Huynh, J.Julien, S.Mirza, F.Netter and J.Simic.
. Acad. Sci. (Paris), Vol. 249, No. 3, 413-15 (July 20, 1959).
rench.
A time of flight method was used to observe the neutron ure resonances in tungsten and platinum in the neutron energy ge 400 to 1500 eV. By observing energies of capture γ-rays ain of the resonances are attributed to J = 1 states in Pt^{196} and , and the distribution of these levels is discussed. L.L.Green

539.14

4. ON THE LOW LYING LEVELS OF Mn^{55}. II. S.Yanagawa.
hys. Soc. Japan, Vol. 14, No. 4, 539 (April, 1959).
For Pt I, see Abstr. 10029 (1959). The energy splitting of the 5/2, 7/2 states of Mn^{55} have been calculated as a five-body blem in configurational mixing. The method of calculation is ogous to that used in a previous calculation of the same problem g two body mixed configurations. It is reported that the J = 5/2 e is calculated to be the lowest, that the splitting between the and 7/2 state is 0.19 MeV but the 3/2 level position does not ee with the observed value. L.L.Green

539.14

5. EXCITED STATES OF ^{166}Er. P.Boskma and H.de Waard.
clear Phys., Vol. 12, No. 6, 533-51 (Sept. (1), 1959).
The level scheme of Er^{166} has been studied from the decays of ^{166*} (> 30 years) and Tm^{188} (7.7 hr) by means of scintillation and spectroscopic coincidence techniques. A discussion is given out the character of the excited states of Er^{166}.

539.14 : 539.17

6. ENERGY LEVELS OF Na^{22} FROM THE $Mg^{24}(d,\alpha)Na^{22}$ AND $^{25}(p,\alpha)Na^{22}$ REACTIONS. C.P.Browne.
clear Phys., Vol. 12, No. 6, 662-71 (Sept. (1), 1959).
Energy levels of Na^{22} were observed with the $Mg^{24}(d,\alpha)Na^{22}$ and $^{25}(p,\alpha)Na^{22}$ reactions. Bombarding energies in the range of 5.0 to MeV were used, and the alpha particles were recorded with a ad-range spectrograph. Ground state Q-values are 1.954 ± .007 MeV for the first and $-3.153^{+0.012}_{-0.006}$ MeV for the second ction. Excited states, presumably with isobaric spin zero, were nd at 0.585, 0.893, 1.533, 1.944, 1.990, 2.219, 2.576, 2.975, 3.066, 26, 3.713 ± 0.008, 3.949, 4.323 ± 0.008, (4.472 ± 0.008) MeV ±0.005 except where shown otherwise) using the (d,α) reaction. e first and second of these were also seen through the (p,α) ction and, in addition, a T = 1 state at 0.661 ± 0.008 MeV. The ound state Q-value for the $N^{14}(p,\alpha)C^{11}$ reaction was found to be $.928^{+0.035}_{-0.005}$ MeV.

539.14 : 539.17

EXCITED STATES OF CARBON BETWEEN 18 AND 21 MeV.
Abstr. 13680

539.14 : 539.163

LEVELS IN Gd^{156} EXCITED IN THE DECAY OF 5.6 d Tb^{156}.
Abstr. 12648

539.14 : 539.17

13617. SINGLE-PARTICLE STATES OF THE NEUTRON FROM GROSS STRUCTURE IN THE PROTON SPECTRA OF (d,p) REACTIONS. J.P.Schiffer, L.L.Lee, Jr and B.Zeidman.
Phys. Rev., Vol. 115, No. 2, 427-34 (July 15, 1959).

For previous work, see Abstr. 7374 (1958). Systematic gross-structure peaks were observed in the proton spectra from (d,p) reactions on nuclei in the region of atomic weight 60. Measurements at deuteron energies of 4, 10, and 21.6 MeV were made with the energy resolution in the proton detectors considerably worse than the known spacing of levels in these nuclei. In all these measurements, the peaks in the proton spectra stayed at a fixed energy of the captured neutron. Angular distributions obtained with 10 MeV deuterons were analysed in terms of the Butler theory of stripping reactions. It was found that each peak in the proton spectrum corresponded to a specific value of the orbital angular momentum of the captured neutron. The peaks are interpreted as being caused by the shell-model single-particle states of the captured neutron, when these states are smeared out among the many actual levels of the nucleus. Thus the observed gross-structure peaks are believed to correspond to the giant resonances of the complex-potential model of Feshbach, Porter, and Weisskopf. Peaks have been assigned to the $1f_{7/2}$, $2p_{3/2}$, $1f_{5/2}$, $2p_{1/2}$, $1g_{9/2}$, $2d_{5/2}$, $3s_{1/2}$, and $2d_{3/2}$ shell-model states, although these states could not all be identified in every nucleus that was studied. The relative intensities of the peaks are also consistent with this interpretation, except for the $l = 0$ peaks at high excitation energies. Information on the ground-state configurations of the target nuclei has also been obtained from the intensities.

539.14

13618. He^3- AND He^4-INDUCED COULOMB EXCITATION.
D.A.Bromley, J.A.Kuehner and E.Almqvist.
Phys. Rev., Vol. 115, No. 3, 586-98 (Aug. 1, 1959).

In order to examine the characteristics of the He^3-induced Coulomb excitation process and the validity of the cross-section ratio technique for the identification of both E1 and E2 transitions, thick-target radiation yield ratios were measured for He^3- and He^4-induced Coulomb excitation of each of the 110 and 197 keV levels of F^{19}, the 446 keV level of Na^{23}, the 160 keV level of Ti^{47}, and the 126 keV level of Mn^{55} at corresponding (equal ξ) energies. For the E2 transitions a mean ratio of the He^3- to He^4-induced yields of 0.63 ± 0.02 was found, independent of incident energy in the range 1.0 to 2.5 MeV, in agreement with the calculated value of 0.64 for F^{19} and Na^{23} and of 0.63 for Ti^{47} and Mn^{55}. In the single E1 transition (110 kev in F^{19}) studied, the experimental ratios range from 0.76 ± 0.07 at $E_{He^3} = 1.00$ MeV to 0.59 ± 0.11 at $E_{He^3} = 1.75$ MeV. While in accord with the theoretical prediction of 0.76 at the lower energies, the indicated energy dependence of the ratio is suggestive of contributions due to nuclear inelastic scattering of alpha particles. It has been demonstrated that the ratio technique, using He^3 and He^4 ions, provides an unambiguous multipolarity determination provided that inelastic-scattering contributions can be excluded.

539.14

13619. ANGULAR CORRELATION MEASUREMENTS IN O^{15}.
B.Povh and D.F.Hebbard.
Phys. Rev., Vol. 115, No. 3, 608-13 (Aug. 1, 1959).

An accurate measurement of the energy of a gamma transition from the 7.56 MeV level in O^{15} discloses that the transition takes place to the 5.19 MeV level in O^{15} rather than to the 5.25 MeV level. Another transition takes place through the 6.15 MeV level. The third known transition occurs through the 6.79 MeV level rather than through the 6.86 MeV level. The angular correlations of cascades from the 7.56 MeV level through the levels at 6.79, 6.15 and 5.19 MeV are measured. These results, combined with previcus results on these levels are consistent only with $J^\pi = \frac{3}{2}^+$ and $\frac{3}{2}^-$, respectively, for the 6.79 and 6.15 MeV levels. For the 5.19 MeV level, the present results indicate $J = \frac{1}{2}$, but are consistent also with $J = \frac{3}{2}$, if a suitable mixing ratio of E2 to M1 radiation is chosen. The preferred assignments are all consistent with the shell-model predictions and with comparisons with the N^{15} level scheme. It is noted that the doublets near 5.2 MeV in O^{15} and N^{15} are reversed in order.

539.14 : 539.17

O^{20}: PRODUCTION BY TRITON BOMBARDMENT OF O^{18}.
See Abstr. 13669

539.14

13620. NATURE OF NUCLEAR MATTER IN THE FREE-MESON LATTICE MODEL. L.E.H.Trainor and P.C.Sood.
Nuclear Phys., Vol. 12, No. 6, 625-8 (Sept. (1), 1959).

Possible types of structure of nuclear matter arising from the "atomic" model for the physical nucleons are considered and some of their properties discussed.

539.14

13621. TRIPLE ISOMERISM IN Ir^{192}.
G.Scharff-Goldhaber and M.McKeown.
Phys. Rev. Letters, Vol. 3, No. 1, 47-50 (July 1, 1959).

Re-examination of the activity of an iridium sample irradiated by pile neutrons 8 years previously indicated a further isomeric state in Ir^{192} in addition to the known 1.45 min isomer. The half-life of the isomer was greater than 5 years. Studies of the L X-rays and conversion electrons indicated that the isomeric state decays by an E5 transition to the ground state of Ir^{192}. A study of the β-rays from the ground state and 1.45 min isomeric state to states of Pt^{192} was made to elucidate the spins of the ground and two isomeric states of Ir^{192}. A decay scheme with spin is given for Ir^{192} and Pt^{192}.
L.L.Green

539.14

13622. ON THE POSSIBLE EXISTENCE OF HYPERFRAGMENTS WITH MASS NUMBER A = 6. B.Barsella and S.Rosati.
Nuovo Cimento, Vol. 13, No. 2, 458-60 (July 16, 1959).

A variational calculation, with 6 parameters, is done to see whether $_{\Lambda}He^{6}$ and $_{\Lambda}Li^{6}$ are likely to be bound. The wave-function consists of a distorted $_{\Lambda}He^{5}$ together with a proton in a p-state. The result depends sensitively on the assumed range of the nucleon–alpha potential, but it is well within the range of possibility that these hyperfragments are bound. E.J.Squires

539.14

13623. $_{\Lambda}H^{4}$ HYPERFRAGMENT EMITTED FROM AN ANTIPROTON CAPTURE STAR. A.G.Ekspong, Å.Frisk and B.E.Ronne.
Phys. Rev. Letters, Vol. 3, No. 2, 103-4 (July 15, 1959).

A star is described which was created by the capture in flight of an antiproton in a heavy nucleus of a photographic emulsion. The emitted particles included one which came to rest and emitted a π-meson and a low-energy recoil. This particle is believed to be a $_{\Lambda}H^{4}$ which underwent a two-body decay to form $\pi^{-} + He^{4}$.
S.J.Goldsack

539.14

13624. THE POSSIBILITY OF ESTIMATING THE MEAN LIFE-TIME OF ALPHA PARTICLES WITHIN NUCLEI.
Yu.I. Serebrennikov.
Zh. eksper. teor. Fiz., Vol. 35, No. 3(9), 789-91 (Sept., 1958).
In Russian. English translation in: Soviet Physics–JETP (New York), Vol. 35(8), No. 3, 547-8 (March, 1959).

Assuming a simple analytic form for the knock-out alpha particle spectrum, the conditions for existence of alpha-particle structures within nuclei of low A are estimated as a function of the bombarding energy. S.J.St-Lorant

RADIOACTIVITY

539.16

13625. REMARKS ON PARTICLES WITH ABNORMAL RANGE FROM RADIOELEMENTS. M.Ader and M.P.Cabannes.
J. Phys. Radium, Vol. 19, No. 6, 615 (June, 1958). In French.

It is suggested that these particles are protons. Yet, an explanation in terms of secondary reactions (α, p) with N, C, O is impossible. J.Lascoux

539.16

13626. ANALYSIS OF FALLOUT PARTICLES FROM TECHNICAL NUCLEAR EXPERIMENTS. A.Sittkus.
Naturwissenschaften, Vol. 46, No. 12, 399 (1959). In German.

Describes the measurement of β and γ activity ($3.2 \times 10^{-3}\mu c$ and $4.0 \times 10^{-3}\mu c$ respectively) of a large fragment found in the course of a routine air-activity analysis at Freiburg, Germany. The size of the fragment is estimated to be of the order of 7 μ, and from the γ-spectrum the active constituents are determined.
S.J.St-Lorant

539.16.0

13627. ABSOLUTE MEASUREMENT OF RADIOACTIVE SOURCE STRENGTHS WITH THE AID OF A MODIFICATION OF THE COINCIDENCE METHOD. K.P.Meyer, P.Schmid and P.Huber.
Helv. phys. Acta, Vol. 32, No. 5, 423-44 (1959). In German.

A new development of the coincidence method makes it now applicable to wide classes of disintegration schemes and all kinds of radiation. Using over all counter responses (W) of less than 0.01, the new method constitutes the limiting case ($W \ll 1$) just opposite to the 4 π-counter ($W \cong 1$). By making the counters roughly equally sensitive for both coincidence radiations, counter response and solid angle vanish quite generally from the expressions for the source strength. Practical methods are given for the realization of equal response for both radiations with scintillation counters. A difference in response of 10% makes only an error of 0.3% in the value of the absolute source strength. Corrections are considered for source extension, angular correlation and finite resolving power of the apparatus. Generally, the precision of the absolute values will be at least 1%; in favourable cases 0.2% is possible. Measurements with Na^{2}, Co^{60}, Na^{22} and Au^{198} are given.

539.16

13628. A COMPARISON OF ADIABATIC MICROCALORIMETRIC METHODS AND DIFFERENTIAL IONIZATION METHODS IN THE PRECISE MEASUREMENT OF RADIOACTIVE HALF-LIVES. J.Robert.
Ann. Phys. (Paris), Ser. 13, Vol. 4, No. 1-2, 89-146 (Jan.-Feb., 1959). In French.

A detailed description is given of the differential ionization chamber and the calorimeter used at the Curie Laboratory for Standardization measurements of radioactive substances. Experimental techniques and corrections applied to the data are also described. Using the ionization chamber the half-lives of Bi^{210} (Ra P^{32} and Be^{7} were measured with better accuracy than previously reported. Measurements of the half-lives of Rn^{222}, Ra^{227}, Ra^{223} (Ac were made using the calorimeter. The calorimeter was also used for precise comparison of radium standards.
A.E.I.Research Laboratory

539.16

13629. GOLD AND MERCURY ISOTOPES OF MASS NUMBER 190
G.Albouy, R.Bernas, M.Gusakow, N.Poffé, J.Teillac.
C.R. Acad. Sci. (Paris), Vol. 249, No. 3, 407-9 (July 20, 1959).
In French.

Hg^{190} was produced by (p,xn) reactions produced by irradiating gold targets by protons from a synchrocyclotron and separated in a double deflection mass separator. The half life for the decay of Hg^{190} to Au^{190} by electron capture was measured as 21 ± 2 min, the decay being accompanied by γ-rays of 140 ± 5 keV (100) and 220 ± 10 keV (10). The half life of Au^{190} was measured as 45 ± 3 m and was accompanied by γ-rays of energy 290 ± 10 keV (100); 600 ± 10 keV (5); [1.04 MeV (0.13)]; 1.40 MeV (0.11); 1.76 MeV (0.0 2.08 MeV (0.04); [2.28 MeV (0.05)]; 2.40 MeV (0.08); 2.70 MeV (0.0 2.94 MeV (0.05); 3.25 MeV (0.02); 3.46 MeV (0.01).
A.E.I. Research Laborator

539.1

13630. SCINTILLATION COUNTER MEASUREMENTS OF THE WEAK ACTIVITIES OF CARBON 14 AND TRITIUM. R.Bibron.
Onde elect., Vol. 39, 40-5 (Jan., 1959). In French.

Carbon 14 and tritium were incorporated in liquid phosphorus in order to provide high detecting efficiency for the weak low-energy β-activities. The background counting rates were reduced by refrigeration of the photomultipliers and by using a coincidence method. It was estimated that activities down to 2×10^{-12} curie of tritium could be detected in a 24 hour run.
A.E.I. Research Laborato

539.1

13631. ON THE DISINTEGRATION SCHEME OF THE LONG-LIVED ISOMER OF TECHNETIUM 95.
C.Lévi, L.Papineau, C.Latapie-Redon and N.Saunier.
C.R. Acad. Sci. (Paris), Vol. 249, No. 3, 410-12 (July 20, 1959).
In French.

The decay scheme of Tc^{95} was studied by coincidence methods angular correlations and measurements of conversion coefficients Branching ratios and spins for states in Mo^{95} were obtained.
L.L.Gre

539.163

32. DECAY OF Tb^{156} (5 DAY). S.Ofer.
s. Rev., Vol. 115, No. 2, 412-20 (July 15, 1959).
Radioactive Tb^{156} (~ 5 day) was produced by the bombardment of ^{153} with α-particles. It was found to decay by K-capture to Gd^{156}. ecay scheme has been proposed which includes the following ited states of Gd^{156}: 89 keV (2+), 289 keV (4+), 581 keV(6+), 4 keV (2+), 1229 keV (3+), 1489 keV (4+), 1604 keV, 1904 keV (3), 2024 keV (4–). The assignments of spins of levels and multi- arities of gamma-ray transitions are based on the results of asurements of conversion coefficients and $\gamma-\gamma$ angular correla- ns. A value of $(1.5 \pm 0.3) \times 10^{-10}$ sec was found for the mean life he 289 keV level of Gd^{156}. The level scheme is discussed in the nt of the unified model. The results support the suggestion that 1134 and 1229 keV levels should be interpreted as collective rational levels.

539.163

33. THE BRANCHING RATIO OF PRASEODYMIUM 142.
Freiberg and K.Goebel.
Naturforsch., Vol. 14a, No. 7, 679 (July, 1959). In German.
Describes the use of the $\beta-\gamma$ coincidence technique to deter- ne the fraction $\alpha = (3.7 \pm 0.4)\%$ of the decays of Pr^{142} proceeding the 1.57 MeV channel of Nd^{142}. S.J.St-Lorant

539.164 : 539.14

34. α-DISINTEGRATION OF Th^{227} ACCORDING TO THE OLLECTIVE MODEL AND SPIN OF Ra^{223} IN ITS GROUND STATE.
.Ryzhanov.
. eksper. teor. Fiz., Vol. 36, No. 3, 928-30 (March, 1959). Russian.
It is concluded that the spin of Ra^{223} in its lowest state should be $\frac{5}{2}$. J.Lascoux

539.165

35. ABSOLUTE MEASUREMENTS OF β-ACTIVITY. PLICATION TO THE DETERMINATION OF THE MILLIGRAMME EQUIVALENT. S.Vuccino.
. Phys. (Paris), Ser. 13, Vol. 4, No. 1-2, 147-84 (Jan.-Feb., 1959). French.
Methods of standardizing absolutely both weak and strong radio- ive sources are described. Details include source preparation, γ and $\gamma-\gamma$ coincidence methods and a discussion of errors. sults are presented for sources of Cu^{64}, Na^{24}, Sc^{46}, Au^{198}, Na^{22}, Co^{60} Cs^{137}. The milligramme Ra equivalent is determined for all se radioelements except Na^{22} and Au^{198}.
A.E.I.Research Laboratory

539.165

36. ELECTRON POLARIZATION IN FIRST FORBIDDEN BETA ANSITIONS WITH SPIN CHANGE $\Delta J = \pm 1$. B.Kuchowicz.
ll. Acad. Polon. Sci. Ser. Sci. math. astron. phys., Vol. 7, No. 5, 9-93 (1959).
An extension of Abstr. 6091 of 1959. Formulae for the calcula- n of the electron polarization are given. E.J.Squires

539.165 : 530.145

LEPTON CONSERVATION AND TIME REVERSAL IN β-DECAY.
e Abstr. 13001

539.165

37. MULTIPOLARITIES OF U^{233} TRANSITIONS.
Maack Bisgård, P.Dahl and K.Olesen.
clear Phys., Vol. 12, No. 6, 612-18 (Sept. (1), 1959).
Multipolarities for twelve gamma transitions in the beta decay Pa^{233} have been determined on the basis of relative conversion efficients measured with a six gap spectrometer. Spin and parity ve been assigned to all corresponding levels in U^{233}. Some con- rsion line interpretations differ from those of previous authors d a few formerly unreported electron lines have been observed.

539.165

38. NUCLEAR STATES IN THE RaE β-DECAY.
Newby, Jr and E.J.Konopinski.
ys. Rev., Vol. 115, No. 2, 434-44 (July 15, 1959).
It is shown that the β-transforming neutron of Bi^{210} most probab- has an $i_{11/2}$ character, despite a $g_{9/2}$ character of the ground-state utron in Pb^{209}. This makes a critical difference to the RaE spec- m parameter, $\xi = i\langle r\rangle/\langle\sigma \times r\rangle$, yielding $\xi \cong +1$ rather than $\cong -1/10$. The effect of configuration mixing is also investigated but does not affect ξ appreciably. To arrive at the above conclusions, it is necessary to show that the neutron–proton attraction in the $(h_{9/2}i_{11/2})_1$ state is the large amount, 840 keV, greater than in the $(h_{9/2}g_{9/2})_0$ state. The resulting shell-model problem has interest independent of the β-theory application which was the original objective of this work. True and Ford had found that two neutrons extra to the doubly-magic core, Pb^{208}, as against nucleons deep in the core matter, interact with about the same strength and range of force as do two free nucleons. The problem here checks the extension of that important finding to neutron–proton and proton–proton pairs. The force strength is consequently not used as an adjustable parameter, as it has been in previous approaches to such problems. The True–Ford problem involved only singlet, central forces between like nucleons in an essential way. The RaE daughter, Po^{210}, investigated here, has only Coulomb repulsion superposed. The resultant comparison with experiments is about as good as that obtained by True and Ford. The extension to the neutron proton pair of Bi^{210} is far more complex, since triplet forces, and exchange character, and non-central forces, may now come into play. One finds that the finite-range, central forces alone cannot give substantially more attraction in the $(h_{9/2}i_{11/2})_1$ state than in $(h_{9/2}g_{9/2})_0$. Even using the strength as a parameter cannot help significantly. However, the tensor forces produce attraction in the former and repulsion in the latter state. Hence, the two-body forces must be imitated even in this detail in order to yield an explanation of the RaE level scheme. This is unfortunate for quantitative results, because the strength of the two-body tensor force seems never to have been determined unambiguously for potentials without cores. The authors' final conclusion is that the two-body neutron–proton force may be well represented by zero-range forces of the same volume energy as found experimentally. Tensor effects vanish identically in this limit and so an unambiguous representation of the strength can be obtained. The results for the relative positions of the J = 0 and 1 states, used as the test above, now turn out in almost perfect agreement with the observations. Configuration mixing plays a role in this result, and, in consequence, the work includes a generalization of de-Shalit's formulae, for the interaction energies with zero-range forces, to nondiagonal matrix elements.

539.165

13639. DECAY OF $_{62}Sm^{155}$ (23.5 MIN). L.C.Schmid and S.B.Burson.
Phys. Rev., Vol. 115, No. 2, 447-9 (July 15, 1959).
The decay of Sm^{155} (23.5 min) is characterized by beta emission to excited states in Eu^{155}. This activity was studied by means of the Argonne 256-channel scintillation coincidence spectrometer. Sources were prepared by neutron irradiation of samarium oxide, enriched in Sm^{154}, in the Argonne reactor CP-5. Three gamma-ray transitions and two beta-ray branches are reported. These radiations are fitted into a decay scheme which indicates the presence of excited states in Eu^{155} at 105 and 246 keV. The total decay energy is found to be 1.8 ± 0.1 MeV. Possible spin and parity assignments for each of the levels are discussed.

539.165

13640. BETA DECAY ENERGY OF TRITIUM. F.T.Porter.
Phys. Rev., Vol. 115, No. 2, 450-3 (July 15, 1959).
The extrapolated end point from Kurie plots of the tritium beta spectrum between 14 and 18 keV was measured as 18.61 ± 0.02 keV (internal consistency) on the Argonne double-lens beta spectrometer. Composite sources of tritiated estradiol and 10 hr thorium B (Pb^{212}) and its daughters allow calibration at 25 keV (the "A" line) as well as some check on the effect of the source thickness on the "A" line. A review of other measurements, including mass difference data, average energy determination, and proportional counter work, shows agreement with the present magnetic spectrometer result, 18.6 ± 0.1 keV (this error includes some estimate of possible systematic effects). Two notable exceptions give lower values, 18.2 and 18.0 keV — one an average energy determination, the other a magnetic spectrometer result. The 18.0 keV decay energy and a half-life of 12.43 years give ft = 1137 ± 20 sec.

539.165

13641. ELECTROMAGNETIC CORRECTIONS TO THE B^{12}–N^{12} β-SPECTRUM RATIO. M.Gell-Mann and S.M.Berman.
Phys. Rev. Letters, Vol. 3, No. 2, 99-101 (July 15, 1959).
The B^{12}–N^{12} β-spectrum ratio provides a possible test of the vector current theory of β-decay, and the purpose of this work is to see whether electromagnetic corrections spoil this test. Seven different electromagnetic effects are considered, and it is indicated how these can be calculated with reasonable accuracy. They all turn

out to be very small compared to the effect which is being looked for in this experiment. E.J.Squires

539.165

13642. POLARIZATION OF β-ELECTRONS FROM RaE.
B.V.Geshkenbein, S.A.Nemirovskaya and A.P.Rudik.
Zh. eksper. teor. Fiz., Vol. 36, No. 2, 517-25 (1959). In Russian.

Effects due to nonconservation of parity are considered. A formula is derived for longitudinal polarization of β-electrons. The magnitude of the longitudinal polarization is found not to equal v/c. The complete calculation is performed taking account of the possibility that time parity may not be conserved. The experimental data relating to the magnitude of the polarization of the RaE β-electrons significantly restrict the region of possible violation of time parity.

539.165

13643. POLARIZATION OF β-PARTICLES AND β–γ-CORRELATION FOR FIRST FORBIDDEN TRANSITIONS IN ORIENTED NUCLEI. A.Z.Dolginov and N.P.Popov.
Zh. eksper. teor. Fiz., Vol. 36, No. 2, 529-38 (1959). In Russian.

Explicit formulae are obtained for the polarization of β-particles and β–γ-correlation for first-forbidden transitions in oriented nuclei. All five types of β-coupling are considered with account of parity nonconservation. The Coulomb field of an extended nucleus is considered. Nonoriented nuclei are examined as a particular case.

539.165

13644. CORRELATION BETWEEN THE DIRECTION OF AN INTERNAL BREMSSTRAHLUNG QUANTUM AND CIRCULAR POLARIZATION OF A γ-QUANTUM EMITTED BY AN EXCITED NUCLEUS AFTER K-CAPTURE. G.M.Gandel'man.
Zh. eksper. teor. Fiz., Vol. 36, No. 2, 585-7 (1959). In Russian.

The correlation between the γ-quantum from radiative K-capture and the circularly polarized γ-quantum from an excited nucleus is studied. A general formula has been deduced for the correlation and its dependence on the spins of the initial, excited and final states of the nuclei.

539.166

13645. ENERGY DISTRIBUTION OF EXTERNAL BREMSSTRAHLUNG FROM β-RAYS OF ^{90}Y. C.Bussolati.
Nuovo Cimento, Vol. 13, No. 5, 909-15 (Sept. 1, 1959).

The external bremsstrahlung spectrum from β-rays of Y^{90} stopped in Al, Ag and Pb was investigated between 0.4 and 2 MeV. The experimental spectra are compared with the theoretical ones, calculated according to the Bethe–Heitler formula for external bremsstrahlung cross-section. A disagreement (535% for Pb at 2 MeV) increasing with energy and Z is shown.

539.166

13646. CONTRIBUTION TO THE STUDY OF GAMMA-TRANSITIONS IN SOME LIGHT NUCLEI. T.Muller.
Ann. Phys. (Paris), Ser. 13, Vol. 3, No. 9-10, 739-800 (Sept.-Oct., 1958). In French.

The radiative decay of the excited levels produced in the reactions:

(1) $Ne^{20}(d,p)Ne^{21*}(\gamma)Ne^{21}$,
(2) $F^{19}(d,\alpha)O^{17*}(\gamma)O^{17}$,
(3) $Mg^{24}(d,p)Mg^{25*}(\gamma)Mg^{25}$

was investigated; the incident bombarding particle energies in the three cases were 1.05 MeV, 1.20 MeV and unstated respectively. The excitation curve for (1) is assumed to be compatible with an excited state of Na^{22}; examination of the γ-transitions of Ne^{21*} then yields $\frac{3}{2}$ for the probable value of the spin of the second excited level in this nucleus. A similar deduction is made for (2). The γ-de-excitation of Mg^{25*} in (3) is examined in the light of similar behaviour of the mirror nucleus Al^{25} and the Bohr–Mottelson model is applied to calculate the energy of the rotation bands. The coincidence circuitry, counting chambers and crystal arrangements are fully described, special attention being paid to the design of the gaseous targets used. S.J.St-Lorant

539.166 : 539.14

THE APPLICATION OF THE ANGULAR CORRELATION METHOD TO THE EXPERIMENTAL INVESTIGATION OF LEVELS IN SEVERAL LIGHT NUCLEI. See Abstr. 13611

539.16

13647. GAMMA ANGULAR DISTRIBUTION FOR ELECTRICAL EXCITATION OF DEFORMED ODD–EVEN NUCLEI.
J.de Boer, M.Martin and P.Marmier.
Helv. phys. Acta, Vol. 32, No. 5, 377-411 (1959). In German.

The yield and angular distribution of the radiation following electric excitation of Eu^{151}, Eu^{153}, Gd^{155}, Gd^{157}, Dy^{163}, Er^{167}, Yb^{173}, Hf^{177}, Hf^{179}, Re^{185} and Re^{187} have been measured using 4 MeV protons. Transition probabilities and mixing ratios as well as moment of inertia, deformation parameter and nuclear gyromagneti ratios are deduced from experimental results.

539.16

13648. THE LEVEL SCHEME OF ^{134}Ba. SOME FEATURES OF THE NaI SUMMING SPECTROMETER.
R.K.Girgis and R.Van Lieshout.
Nuclear Phys., Vol. 12, No. 6, 672-88 (Sept. (1), 1959).

A detailed analysis of the gamma-ray spectrum from Cs^{134} was performed. The results are in agreement with previous measurements, but two additional weak gamma rays of 960 and 1570 keV were found. Summing peaks of 1.17, 1.40, 1.57, 1.64, 1.77 and 1.97 MeV were observed, establishing the presence of levels of these energie in Ba^{134}. The gamma-ray spectrum from the decay of La^{134} was als examined. Only one gamma ray of 605 keV was observed, thus con firming that the first 2^+ level in Ba^{134} has this energy. Some featur of the NaI summing spectrometer are demonstrated and discussed.

539.16

13649. Fe^{59} DECAY SCHEME. J.M.Ferguson.
Nuclear Phys., Vol. 12, No. 6, 579-88 (Sept. (1), 1959).

The gamma-ray spectrum of 45 day Fe^{59} was investigated with scintillation detectors. In addition to the previously reported gamm rays at 0.19, 1.10, and 1.29 MeV, gamma rays at 0.14 and 0.33 MeV were observed. The positions of these gamma rays in the decay scheme are established from the gamma-ray energies and coincidence measurements. It is concluded that a level in Co^{59} at 1.43 MeV with a character of $\frac{1}{2}-$ is weakly excited by the Fe^{59} beta decay.

539.166

13650. CONVERSION ELECTRON ANGULAR CORRELATIONS: GENERAL K-SHELL FORMULATION AND THRESHOLD LIMIT.
R.C.Young.
Phys. Rev., Vol. 115, No. 3, 577-85 (Aug. 1, 1959).

A general treatment of polarization–angular correlations involving conversion electrons is presented. Formulae are given for the b_ν coefficients for all types of polarization of the conversio electron, electric and magnetic multipoles, and arbitrary complexi ν. It is shown that only three coefficients are needed to characteri completely correlations of conversion electrons from the K shell, for a given type of transition. Curves are given of the threshold values for these coefficients for L = 1-5, electric and magnetic, v. atomic number. The relativistic Coulomb functions (point nucle no screening) are presented, along with a number of properties and expansions, in a convenient and consistent notation. Several identities and relations involving the vector addition coefficients are included.

539.16

13651. SEMICLASSICAL THEORY OF INTERNAL RAYLEIGH SCATTERING. A.M.Cormack.
Phys. Rev., Vol. 115, No. 3, 619-23 (Aug. 1, 1959).

For previous work, see Abstr. 4040 (1955). The angular distribution of the gamma rays emitted by a bare nucleus with a fixed orientation in space may be modified if the nucleus is surrounded by electrons, because of the elastic scattering of gamma rays by the electrons. A general expression is given for the angula distribution of the radiation from arbitrary electric and magnetic multipoles scattered by arbitrary electron distributions on the basi of a classical model, and an "internal scattering coefficient" is given explicitly for spherically symmetrical electron distributions. Although the radiation scattered from spherically symmetrical charge distributions is indistinguishable from the unscattered radia tion, the internal scattering coefficient was calculated for these on the basis of a Thomas–Fermi atom so that an indication may be ob tained of the smallness of the scattering from asymmetries in atomic electron distributions due to molecular or crystal binding effects.

NUCLEAR REACTIONS

539.17

652. EFFECTIVE POTENTIAL APPROACH TO THE IRESHOLD BEHAVIOUR OF CROSS SECTIONS. L.Fonda.
ovo Cimento, Vol. 13, No. 5, 956-68 (Sept. 1, 1959).

The study of the energy dependence of scattering and reaction oss-sections near thresholds is performed by a method which has the construction of the effective potentials in every single channel. e formalism employed presents some advantage with respect to ner kind of approaches in that it gives a simple physical descrip- n of the anomaly (cusp or rounded step) which appears in the attering cross-section at the opening up of a new channel. rthermore, with this method it is effectively possible to give an planation why the energy derivative of the scattering cross-section infinite when the threshold is approached from below. The effect found to be purely quantum mechanical.

539.17

653. APPLICATION OF THE CHEW–LOW FORMALISM OF ULTI-CHANNEL REACTIONS. B.W.Lee and A.Klein.
ovo Cimento, Vol. 13, No. 5, 891-908 (Sept., 1, 1959).

The Low equation for a non-relativistic scattering process is vestigated, using a model in which the scattering source can exist more than one state, and the "average" interaction between the urce and the particle is factorizable. The branching ratio theorem d the optical theorem are derived directly from the Low equation. e Low equation is solved by the method of Castellejo, Dalitz and rson, and the unique solution is determined by investigating the ectrum of the unperturbed Hamiltonian. The resonance phenomena e studied and the Breit–Wigner resonance formula is derived lizing the properties of the generalized R-function. The more neral applicability of the method is indicated.

539.17 : 537.54

654. CYCLOTRON TARGET FOR THE IRRADIATION OF HEMICAL COMPOUNDS. J.A.Martin and F.L.Green.
uclear Sci. Engng, Vol. 1, No. 2, 185-90 (May, 1956).

A capsule-type target is used with the Oak Ridge 86 in. cyclo- on for increased production rates of radioisotopes such as F^{18}, ^{85}, Y^{88}, I^{125}, and I^{130}. The target is economical for irradiation of aterials which are scarce or expensive, e.g. enriched isotopes and re earths, and materials which yield gaseous products.

539.17

655. EXCITATION OF NUCLEI BY HIGH-ENERGY PARTICLES. .Z.Maksimov.
n. eksper. teor. Fiz., Vol. 36, No. 3, 922-4 (March, 1959). Russian.

Neutron slowing-down theory is applied to obtain analytical pressions for the average number of emitted nucleons, and for e average residual excitation as functions of the bombarding ergy and of the mass number of the target. J.Lascoux

539.17 : 539.14

IMAGINARY OPTICAL POTENTIAL FOR NUCLEONS.
e Abstr. 13589

539.17 : 539.12

μ-MESON AND THE CATALYSIS OF NUCLEAR REACTIONS.
e Abstr. 13559

539.17 : 523.855

NUCLEAR REACTIONS IN COLLISIONS OF GALAXIES.
e Abstr. 12966

539.17

656. ANGULAR DISTRIBUTION IN PROCESSES IN WHICH A EUTRON IS REMOVED FROM Be^9 AT LOW ENERGIES.
G.de Pinho Filho.
n. Acad. Brasil. Cienc., Vol. 31, No. 1, 1-16 (1959). In Portuguese.

Using a two-body model and the Born approximation, the fferential cross-section is calculated for the reactions $Be^9(p,d)Be^8$ d $Be^9(d,t)Be^8$. The effect of the Coulomb field is neglected. esults are compared with experimental data. L.Pincherle

539.17

657. ELASTIC AND INELASTIC SCATTERING OF PROTONS ROM NEON. M.Kondo and T.Yamazaki.
J. Phys. Soc. Japan, Vol. 13, No. 8, 771-6 (Aug., 1958).

The angular distributions of protons elastically scattered from Ne and inelastically scattered from Ne^{20} (Q = −1.63 MeV) were measured from 30^0 to 165^0 in the laboratory system at bombarding energies of 4.7, 4.9, 5.1, 5.3 and 5.5 MeV. Photographic plates were employed for the detection of scattered particles. The distributions for the elastic scattering of protons varied markedly with the primary energies, while the five distributions for the inelastic scattering had roughly similar shapes.

539.17

13658. ANGULAR DISTRIBUTION OF PROTONS INELASTICALLY SCATTERED FROM Si^{28} AND Mg^{24}.
S.Yamabe, M.Kondo, T.Yamazaki and A.Toi.
J. Phys. Soc. Japan, Vol. 13, No. 8, 777-81 (Aug., 1958).

The angular distributions and the excitation curves of protons inelastically scattered from Si^{28}(Q = −1.78 MeV) and Mg^{24}(Q = = −1.37 MeV) were measured in the energy range E_p = 4.8 to 5.7 MeV. A broad resonance was observed in each excitation functions. The angular distributions in Mg^{24} show an asymmetry about the centre-of-mass scattering angle $\theta = 90^0$ and a strong dependence with the energy of incident protons, while in Si^{28} the angular distributions are rather more symmetric than in Mg^{24}.

539.17

13659. ELASTIC SCATTERING AND CAPTURE OF PROTONS BY C^{14}. D.F.Hebbard and D.N.F.Dunbar.
Phys. Rev., Vol. 115, No. 3, 624-32 (Aug. 1, 1959).

The reaction $C^{14}(p,p)$ was investigated over the energy range from 340 to 690 keV. No wide anomalies are found, but a narrow anomaly at 527 keV has been attributed to d-wave protons forming a state of spin $\frac{3}{2}^+$. The reaction $C^{14}(p,\gamma)$, investigated over the range from 250 to 690 keV, shows a resonance at 261 keV in addition to the three previously known resonances at 351, 527, and 634 keV. Proton and radiative widths are obtained for all these resonances, and limits are placed on the spin assignments. From the data obtained, it is clear that the levels corresponding to the resonances at proton energies of 261, 351, and 527 keV cannot contribute significantly to the scattering or capture of low-energy neutrons by N^{14}. In addition, the level corresponding to the 634 keV resonance cannot be responsible for the whole of the N^{14} + n cross-section at low energies, but it may be responsible for part of this cross-section. It is suggested that the level at 9.84 MeV is responsible for the remainder of this cross-section. A good fit to the neutron elastic scattering cross-section is obtained over the neutron energy range from 0 to 600 keV.

539.17

13660. ELASTIC SCATTERING OF PROTONS BY VANADIUM, CHROMIUM, IRON, AND COBALT. C.A.Preskitt and W.P.Alford.
Phys. Rev., Vol. 115, No. 2, 389-97 (July 15, 1959).

Thirty-three angular distributions of elastically scattered protons were measured in the energy range from 3.49 to 6.42 MeV. It was observed that the angular distributions measured with V and Co have similar shapes at all energies. Likewise the angular distributions with Cr and Fe are similar, but wualitatively different from those with V and Co. By using the optical model it has been possible to obtain fits to some of the data for V and Co, but the large cross-section at large angles prevents an adequate fit to the Cr and Fe data. Calculations are presented which indicate that this failure of the optical model is due to the presence of compound elastic scattering from Cr and Fe.

539.17

13661. GAMMA RADIATION FROM PROTON CAPTURE IN ALUMINIUM AT THE 991 keV RESONANCE. M.Brenner.
Comment. phys.-math. (Helsinki), Vol. 23, No. 5, 35 pp. (1959).

The energies and relative intensities of gamma rays, resulting from proton capture in aluminium, were measured at the 991 keV resonance. Radiation of energies 12.6, 10.8, 8.04, 6.07, 4.66, 2.86 and 1.8 MeV has been observed and explained in terms of a level scheme for Si^{28}. Two other rays observed in the spectrum could not be explained by means of the proposed scheme. The angular distribution of the 10.8 MeV radiation, as obtained from the experiment, is compared with the theoretical distribution. The spin assignments of the levels are discussed. An assignment 3^+ or 2^- for the compound state is consistent with the experimental result.

539.17

13662. GAMMA RAYS FROM THE PROTON BOMBARDMENT OF ^{24}Mg, ^{25}Mg AND ^{26}Mg.

I.Miura, T.Wakatsuki, Y.Hirao and E.Okada.
J. Phys. Soc. Japan, Vol. 14, No. 3, 239-47 (March, 1959).

Investigated at proton energies up to 5.7 MeV. The energy spectra of the gamma-rays at several proton energies were obtained for each isotopes. 2^+ was assigned to the second, third and fourth excited levels of Mg^{26}, by considering the gamma-ray branching ratios for those levels. The yields of gamma-rays from the first excited levels were found to have peaks at proton energies of 4.0, 4.6 and 5.05 MeV for $Mg^{24}(p,p'\gamma)$, and 4.9 and 5.4 MeV for $Mg^{26}(p,p'\gamma)$, respectively. These resonances correspond to the levels at 6.1, 6.7 and 7.14 MeV for Al^{25}, and 13.0 and 13.5 MeV for Al^{27}. To determine the spins for those levels, angular distributions were measured at resonance energies. Spin values of 3/2 and 5/2 are probable for 7.14 MeV level in Al^{25} and 13.0 MeV level in Al^{27}, respectively. For the 13.5 MeV level in Al^{27}, a spin of 3/2 is also probable, but 5/2 cannot be excluded because of the presence of the cascade gamma-rays from higher levels. The total cross-sections for the gamma-ray emission are estimated to be about 700 mb at 5.05 MeV resonance for Mg^{24} and a few hundred mb for the 4.9 and 5.4 MeV resonances for Mg^{26}.

539.17

13663. PROTON CAPTURE GAMMA RAYS IN THE GIANT RESONANCE REGION. H.E.Gove, A.E.Litherland and R.Batchelor.
Phys. Rev. Letters, Vol. 3, No. 4, 177-9 (Aug. 15, 1959).

The 90° yield of γ-rays from the reaction $B^{11}(p,\gamma)C^{12}$ was measured, using the Chalk River tandem accelerator, for proton energies up to 11 MeV. The yield of the 1.78 MeV γ-ray to the first excited state shows a general steady increase from 5.5 to 11.4 MeV proton energy with some evidence for broad resonances. The yield of the 4.43 MeV ground state γ-ray shows a broad resonance ~ 3 MeV in width centred at an excitation energy of 22.5 MeV, consistent with photonuclear giant resonance effects. Angular distributions of the latter γ-ray were measured on the resonance at 6.09 and 7.12 MeV proton energy and can be fitted to the expression $W(\theta) = 1 - 0.5\ P_2(\cos\theta)$. These results can be interpreted on the basis of a direct capture mechanism. The yield at 3.09 MeV is spherically symmetrical. The yield of the 1.78 MeV γ-ray at the same four energies is also spherically symmetrical. Similar measurements were made on the yield of the ground and first excited state γ-rays in the reaction $Al^{27}(p,\gamma)Si^{28}$. The 90° yields for both showed marked but dissimilar resonance structure. Measured angular distributions for the ground state radiation at 6.9, 7.2 and 8.4 MeV proton energies require a small positive coefficient of $P_2(\cos\theta)$ whilst the direct capture process would predict a value equal to or less than zero. R.E.Meads

539.17

13664. GAMMA RAYS FROM Si^{29} + p. J.J.Singh.
Phys. Rev., Vol. 115, No. 2, 445-7 (July 15, 1959).

Gamma rays from the reaction $Si^{29}(p,\gamma)$ were investigated at five resonances at proton energies of 414, 696, 737, 916 and 956 keV. Experimental evidence indicating two close-lying levels at about 700 keV above the ground state is presented.

539.17 : 539.12

13665. GENERATION OF π^0-MESONS IN THE INTERACTION BETWEEN ~9 BeV PROTONS AND NUCLEI OF THE PHOTOGRAPHIC EMULSION. G.L.Bayatyan, I.M.Gramenitskiĭ, A.A.Nomofilov, M.I.Podgoretskiĭ and É.S.Skzhipchak.
Zh. eksper. teor. Fiz., Vol. 36, No. 3, 690-3 (1959). In Russian.

The mean energy of π^0-mesons produced in collisions between ~9 BeV protons and photographic emulsion nuclei was determined. The value $\bar{E}_\pi = 750 \pm 180$ MeV was obtained for the mean π^0-meson energy. The fraction of energy carried off by $\pi^{\pm 0}$-mesons in such interactions lies between 0.33 ± 0.08 and 0.27 ± 0.07.

539.17

13666. CASCADE α-PARTICLES FROM DISINTEGRATIONS INDUCED BY 360 AND 660 MeV PROTONS.
I.Ostroumov, N.A.Perfilov and R.A.Filov.
Zh. eksper. teor. Fiz., Vol. 36, No. 2, 367-75 (1959). In Russian.

Stars containing tracks of α-particles with energies above 30 MeV were studied in a nuclear emulsion irradiated by 360 and 660 MeV protons. The effective cross-section for production of these stars, the angular distribution of the fast α-particles and their relative probability for emission from light and heavy emulsion nuclei were determined. Emission of cascade α-particles and emission from nuclei of fragments as a result of bombardment with protons of the same energies have been found to be quite similar. This seems to indicate that the α-particles are produced by an identical type of mechanism.

539.17 : 539.1

ENERGY LEVELS OF Na^{22} FROM THE $Mg^{24}(d,\alpha)Na^{22}$ AND $Mg^{25}(p,\alpha)Na^{22}$ REACTIONS. See Abstr. 13616

539 1

13667. ON THE DETECTION OF DEUTERON POLARIZATION.
L.J.B.Goldfarb.
Nuclear Phys., Vol. 12, No. 6, 657-61 (Sept. (1), 1959).

An investigation is made of the angular distributions and polarizations arising from the use of polarized deuteron beams in the $d(H^3, He^4)n$ and $d(He^3, He^4)p$ reactions.

539.17

13668. DIFFRACTION STRIPPING OF RELATIVISTIC PARTICLE
I.I.Ivanchik.
Zh. eksper. teor. Fiz., Vol. 36, No. 2, 617-18 (1959). In Russian.

It is shown that the earlier results regarding the diffraction stripping of deuterons on a black nucleus are also valid for a relativistic deuteron. The results are then applied for the diffraction production of charged π-mesons by a relativistic proton.

P.Roman

539.17 : 539.1

(d,p) REACTIONS: GROSS STRUCTURE IN THE PROTON SPECTRA. See Abstr. 13617

539.17 : 539.1

13669. OXYGEN-20. N.Jarmie and M.G.Silbert.
Phys. Rev. Letters, Vol. 3, No. 1, 50 (July 1, 1959).

2.6 MeV tritons were used to bombard an oxygen target enriched in O^{18}. Reaction products were analysed magnetically and detected by a scintillation detector. Two proton groups were identified as due to the reaction $O^{18}(t,p)O^{20}$. The Q value for this reaction is given and the energy of the first excited state of O^{20}.

L.L.Gree

539.17 : 537.59

13670. HEAVY NUCLEI AND α PARTICLES BETWEEN 7 AND 100 BeV/NUCLEON. I. INTERACTION MEAN FREE PATHS AND FRAGMENTATION PROBABILITIES.
E.Lohrmann and M.W.Teucher.
Phys. Rev., Vol. 115, No. 3, 636-42 (Aug. 1, 1959).

See also Abstr. 13408 (1959). In a stack of nuclear emulsion exposed to the cosmic radiation near the geomagnetic equator, 540 tracks of heavy nuclei were located in a systematic scan and followed along the track. Twenty-two interactions of light ($3 \leq Z \leq 5$), 218 of medium ($6 \leq Z \leq 9$), and 99 of heavy ($Z \geq 10$) nuclei were found. The average energy of the nuclei in this experiment was about 20 BeV per nucleon. The interaction mean free path for all charge groups are in reasonably good agreement with results obtained at lower energies, indicating that the mean free path is independent of energy within the limits of error. In addition, all the α-particles originating in fragmentations of heavy nuclei were followed. The mean free path of α-particles resulting from fragmentations is again in agreement with results obtained at lower energies. The same is true for the fragmentation probabilities. Fragmentation probabilities in hydrogen are given and their significance is discussed.

539.17 : 537.59

13671. HEAVY NUCLEI AND α PARTICLES BETWEEN 7 AND 100 BeV/NUCLEON. II. FRAGMENTATIONS AND MESON PRODUCTION. P.L.Jain, E.Lohrmann and M.W.Teucher.
Phys. Rev., Vol. 115, No. 3, 643-54 (Aug. 1, 1959).

Three hundred and seventeen heavy-nuclei and 175 α-particle interactions of more than 7 BeV/nucleon were found in a systematic way and analysed. Average values and fluctuations of the individual values were obtained for the energy of heavy nuclei as measured by the opening angle of their fragments by comparing with the energy found by scattering measurements. At an average energy of 10 BeV/nucleon and 40 BeV/nucleon the average number of charged mesons produced by α-particle interactions with emulsion nuclei was found to be 4.6 and 8.2, respectively. About one half of the nucleons of the α-particle participate in the collision. The meson multiplicities per participating nucleon agree for proton and α-particle collisions at 10 BeV/nucleon. The angular distribution of the shower particles emitted from the interactions were measured, and the energy of the interactions were calculated from the angular distribution by using the median angle formula or equivalent formulae, based on the "meson spectrum independent" approximation. These methods overestimate the true primary energy on the average by a factor of 2 (for interactions with less than 5 heavily ionizing prongs). This is due to the relatively large proportion of slow mesons in the c.m.

item. The distribution of primary energy as obtained by this thod around the true value is shown for two groups having average ergies of 10 BeV/nucleon and 40 BeV/nucleon. Equivalent results e given for the heavy-nuclei interactions. The average number of sons produced in collisions between heavy nuclei and emulsion clei at an average energy of 20 BeV/nucleon is given. It increases h the charge of the incident nucleus in agreement with a crude ometrical model.

539.17

672 MEAN-FREE-PATH—ENERGY RELATION FOR NUCLEI , Be^8, B^{11} IN EMULSIONS. V.N.Maikov.
ibory i Tekh. Eksper., 1959, No. 1, 50-3 (Jan.-Feb.). In Russian.
Curves are given from a study of the photonuclear reactions: $^7(\gamma,\alpha p)Li^7$; $N^{14}(\gamma,\alpha p)Be^9$; $O^{16}(\gamma,\alpha p)B^{11}$. J.Lascoux

539.17

673. DIRECT NEUTRON-EXCHANGE INTERACTION OF OMPLEX NUCLEI. V.I.Gol'danskii.
. eksper. teor. Fiz., Vol. 36, No. 2, 526-8 (1959). In Russian.
It is shown that it should be possible to observe the process of ect interaction between complex nuclei in which the nuclei change neutrons when located on the external surface of the ulomb potential barrier. For large values of the moments of utrons in the outer shells a consequence of such a process may be arge change of the spins of the interacting nuclei and an excitation levels which practically should be unattainable any other way. e exponent characterizing the probability of the process under nsideration is estimated.

539.17

674. ON THE FORMATION OF COMPOUND NUCLEUS FOR CACTIONS WITH HEAVY IONS.
S.Karamyan, Yu.B.Gerlit and B.F.Myasoedov.
. eksper. teor. Fiz., Vol. 36, No. 2, 621-3 (Feb., 1959). In ssian.
Excitation functions are studied for

$$Au^{197}(N^{14},xn)\ x = 4, 5, 6$$
$$V^{51}(N^{14},xn)\ x = 2, 3$$
$$V^{51}[(N^{14},4n) + (N^{14},1p3n)]$$

e cross-section is given as a function of the energy of the rresponding compound nucleus. J.Lascoux

539.17

675. TWO-NEUTRON CAPTURE REACTION IN THE INTER-TION BETWEEN N^{14} AND NUCLEI OF SOME ELEMENTS.
A.Karnaukhov, G.M.Ter-Akop'yan and V.I.Khalizev.
. eksper. teor. Fiz., Vol. 36, No. 3, 748-50 (1959). In Russian.
Targets from LiF, Al and Cu were irradiated with ~ 92 MeV ions. Among the reaction products the radioactive isotope N^{16} s detected on basis of its decay period and β-particle energy. s concluded that N^{16} is formed as a result of "capture" of two utrons from the target by the bombarding particle.

539.17

676. THE CROSS-SECTIONS FOR CALIFORNIUM ISOTOPE ODUCTION BY IRRADIATING U^{238} WITH ACCELERATED RBON IONS.
V.Volkov, L.I.Guseva, A.S.Pasyuk, N.I.Tarantin and K.V.Filippova.
. eksper. teor. Fiz., Vol. 36, No. 3, 762-5 (1959). In Russian.
The energy dependence of the reactions $U^{238}(C^{14}, 4n - 5n)Cf^{246-245}$ d $U^{238}(C^{13}, 5n - 6n)Cf^{246-245}$ was investigated. Stacks of foils and diochemical analysis of the reaction products were employed in work. The results obtained indicate that the investigated reac-ns involve the formation of a compound nucleus with subsequent poration of the neutrons. The reaction cross-sections are ployed to estimate the competition between neutron evaporation m the compound nucleus and fission.

539.17 : 523.877

677. PHOTOBETA REACTIONS IN STELLAR INTERIORS.
G.W.Cameron.
trophys. J., Vol. 130, No. 2, 452-64 (Sept., 1959).
Under equilibrium conditions in stellar interiors there is a small ctional population of the excited states of nuclei. Many of these cited states are unstable against the emission of positive and gative beta-particles and against the capture of free electrons. pressions are given for the induced rates of these transforma-ns. Applications are made to the process of heavy-element rmation by neutron capture on a slow time scale which probably accompanies carbon thermonuclear reactions. From a consideration of the abundances of nuclei which are partially shielded against formation by neutron capture, it is shown that the terminal stages of the capture must have involved a temperature of about 7×10^8 °K and a neutron flux of about 3×10^{17} neutrons/cm^2 sec and that the flux must have been quickly terminated within a small fraction of 1 year of the time at which the heavy-element products were frozen. On the longer time scales characteristic of heavy-element formation in red giant stars, it is shown that Nb^{93} can be relatively quickly formed in the stellar interior and that the technetium isotope responsible for the presence of Tc lines in S spectra is probably Tc^{97} rather than Tc^{99}.

539.17

13678. ELECTRON-POSITRON ELASTIC SCATTERING FROM EXTENDED NUCLEI. P.Budini and G.Furlan.
Nuovo Cimento, Vol. 13, No. 4, 790-801 (Aug. 16, 1959).
Second-order Born approximation of electron-positron elastic potential scattering from extended nuclei is calculated, and a general formula is given for any charge distribution. The dependence of $(\sigma_- - \sigma_+)/\sigma_-$ from particular charge distributions is analysed and discussed.

539.17

13679. DISPERSIVE EFFECTS IN ELECTRON-NUCLEUS INTERACTIONS. N.A.Krall and E.E.Salpeter.
Phys. Rev., Vol. 115, No. 2, 457-63 (July 15, 1959).
Elastic scattering of electrons from nuclei is influenced by the possibility of virtual transitions to excited nuclear states in intermediate states. Such dispersive corrections to electron—deuteron elastic scattering are calculated in second-order Born approximation for incident electron energies from 200 to 500 MeV for various values of the momentum transfer. The static second-order Born formulae are also evaluated. Similar, but less accurate, calculations are carried out for He^4, C^{12}, and some heavier elements. These results are used to find small corrections to nuclear radii obtained from an analysis of the Stanford experiments. Dispersive effects on the energy level shifts in bound s-states of hydrogenic atoms are also calculated, using second-order perturbation theory for the deviation of the nuclear charge distribution from a point charge. These small shifts are evaluated for deuterium and He^4 and, less accurately, for other nuclei with $Z < 50$.

539.17 : 539.14

13680. DETERMINATION OF EXCITED STATES OF CARBON BETWEEN 18 AND 21 MeV BY PHOTONUCLEAR REACTIONS. D.Sadeh.
C.R. Acad. Sci. (Paris), Vol. 249, No. 4, 531-3 (July 27, 1959). In French.
The activation curve for the reaction C^{12} (γ,n) C^{11} was measured with a 31 MeV betatron. The slope of the activation curve showed discontinuities indicating resonant absorption. The energies of the discontinuities agreed with previous work. L.L.Green

539.17

13681. PHOTONUCLEAR REACTION ENERGIES.
A.S.Penfold and E.L.Garwin.
Phys. Rev., Vol. 115, No. 2, 420-4 (July 15, 1959).
The general problem of determining photonuclear reaction energies in the region below 25 MeV is discussed, and the need for absolute calibration of betatron energy scales is demonstrated. A system for accomplishing such a calibration is briefly described and the results of some measurements made with it are given. The $Cu^{63}(\gamma,n)Cu^{62}$ threshold was observed to be at 10.78 ± 0.03 MeV, and two well-defined "breaks" in the $O^{16}(\gamma,n)O^{15}$ yield curve are at 16.19 ± 0.04 and 17.25 ± 0.04 MeV. These "breaks" lead to the assignment of energy levels in O^{16} which are in excellent agreement with those observed in the $N^{15}(p,n)O^{15}$ reaction.

539.17

13682. FINE STRUCTURE OF THE ENERGY SPECTRUM OF PHOTOPROTONS FROM Ca^{40}. A.P.Komar and T.N.Dragnev.
Dokl. Akad. Nauk SSSR, Vol. 126, No. 6, 1234-5 (June 21, 1959). In Russian.
A nuclear emulsion technique was employed to investigate the angular distribution, as a function of energy, of the photoprotons generated by an 85 MeV gamma-ray beam on a Ca^{40} target. The distribution has the general form:

$$1 + \alpha(E) \sin^2\theta\,[1 + \beta(E)\cos\theta]^2$$

For the range of proton energies investigated (up to 15 MeV) both α and β are of the order of unity. The energy spectrum integrated over all angles is also presented. J.W.Gardner

539.17

13683. RATIO OF DEUTERON TO PROTON YIELD IN THE PHOTODISINTEGRATION OF Au^{197}. E.D.Makhnovskii.
Zh. eksper. teor. Fiz., Vol. 36, No. 3, 739-43 (1959). In Russian.

The ratio of the photodeuteron yield to the photoproton yield was measured for gold irradiated with 70 MeV maximum energy bremsstrahlung. The ratio was found to equal 0.14 ± 0.07. The protons and deuterons were identified by grain counting over the last 80 μ of the particle range in the emulsion.

539.17

13684. ENERGY SPECTRA AND ANGULAR DISTRIBUTION OF PHOTONEUTRONS FROM OXYGEN. C.Milone and A.Rubbino.
Nuovo Cimento, Vol. 13, No. 5, 1035-52 (Sept. 1, 1959).

Energy spectra and angular distribution of photoneutrons from oxygen were investigated by irradiation of a water target with a collimated 31 MeV bremsstrahlung beam. Photoneutrons emitted at θ angles of 30°, 60°, 90°, 120° and 150° with a γ-ray beam were recorded by means of proton recoil tracks in Ilford L-4400 μ thick photoemulsions. The neutron spectra analysed in 0.5 MeV steps show a fine structure in good agreement with the fine structure found in the proton spectra and in the (γ,n) and (γ,p) cross-sections. From these structures many levels of the O^{16} nucleus are identified which are in good agreement with known levels and some levels given with uncertainty are confirmed. For the $O^{16}(\gamma,n)$ reaction the contribution of direct process appears prevalent while for all elements up to this date investigated evaporation accounts for the greater part of emitted neutrons. The ground state transitions amount to at least 60% of the emitted neutrons. The angular distribution of photoneutrons is analysed separately for single neutron peaks and a back and front asymmetry is found in the region of the giant resonance. Results on the $O^{16}(\gamma,n)$ process up to 31 MeV can be interpreted, in good approximation, in terms of (a) many-level theory for the giant resonance, (b) single-particle transitions, (c) charge independence of nuclear forces.

539.17

13685. ENERGY SPECTRUM OF PHOTONEUTRONS FROM OXYGEN. C.Milone.
Phys. Rev. Letters, Vol, 3, No. 1, 43-4 (July 1, 1959).

Photoneutrons emitted near 90° from a water target irradiated with a 30 MeV collimated γ-ray beam were detected by the proton recoils formed in nuclear emulsions. The results provide evidence for a large contribution from the direct process in the $O(\gamma,n)$ reaction. S.J.Goldsack

539.17

13686. GENERALIZED FORM OF THE DEPENDENCE OF THE π-MESON PHOTOPRODUCTION CROSS-SECTIONS OF COMPLEX NUCLEI ON THE NUMBER OF NUCLEONS.
A.S.Belousov, B.B.Govorkov and V.I.Gol'danskii.
Zh. eksper. teor. Fiz., Vol. 36, No. 1, 244-8 (1959). In Russian.

A generalized formula is deduced which takes into account ordinary reabsorption processes as well as the two-nucleon absorption of mesons at the instant of creation. Two types of calculation are presented: (1) one for a given wave-function of the nucleon pair assuming uniform distribution of nucleon density in the nucleus; (2) a phenomenological one in which the wave-function is not prescribed, but the nucleon density in the nucleus is assumed to be of the Fermi type.

539.17

13687. TOTAL EFFECTIVE CROSS-SECTION OF N^{15} AND O^{16} FOR NEUTRONS IN THE MeV-ENERGY RANGE.
L.Schellenberg, E.Baumgartner, P.Huber and F.Seiler.
Helv. phys. Acta, Vol. 32, No. 5, 357-76 (1959). In German.

The total cross-section of O^{16} for neutrons in the energy range 2.82-4.17 MeV and of N^{15} in the energy range 2.80-3.62 MeV was measured by means of a conventional transmission experiment using the d–d reaction as neutron source. For N^{16} a level at 5.26 MeV excitation energy has been found. Possible spin and parity assignments are 3± or less probably 4^+ or 2^-. For O^{16}, the cross-section shows a complex structure with 4 distinct maxima. Due to over-lapping resonances and possible inelastic scattering an interpretation is difficult. However, by making some simplifying assumptions a reasonable fit to the data was obtained with levels at 6.83, 6.97, 7.26 and 7.73 MeV excitation energy and the spin and parity assignments $3/2^+$ and $1/2^-$, $1/2^-$, $1/2^-$ respectively.

539.17 : 539.18 : 539.1

NEUTRON-CAPTURE CROSS-SECTIONS OF Gd ISOTOPES. See Abstr. 13600

539.1

13688. n,p AND n,np REACTIONS WITH 14 MeV NEUTRONS.
L.Colli, U.Facchini, I.Iori, M.G.Marcazzan and A.M.Sona.
Nuovo Cimento, Vol. 13, No. 4, 730-60 (Aug. 16, 1959).

Measurements of the energy spectra of protons emitted in n,p and n,np reactions with 14 MeV neutrons are described. The spect are taken at four different angles in the case of Ni, Cu, Mo, and Ag The results are compared with other results, in the domain of the nuclear reactions at intermediate energy. The mechanisms respon ible for the various reactions can be shortly indicated: (1) instantaneous effects: the forward emitted high energy particles due to such effects; (2) non-equilibrium escape is responsible for the ma part of the spectra and for emission at any angle: the escape is supposed to be due to the strong interactions between few excited nucleons at the nuclear surface; (3) retarded emission, probably af stabilized equilibrium is reached, will explain the emission of protons by medium A nuclei and of neutrons when incident energy is below 18 MeV. Values of temperatures of ~ 1 MeV are found. In 2n and n, np reactions strong emission of protons competes in som cases with neutron emissions. The role of surface conditions in th retarded emission is discussed.

539.1

13689. EFFECT CAPTURE CROSS SECTION OF Pa-233 FOR THERMAL REACTOR NEUTRONS.
J.Halperin, R.W.Stoughton, C.V.Ellison and D.E.Ferguson.
Nuclear Sci. Engng, Vol. 1, No. 1, 1-3 (March, 1956).

Thorium metal was irradiated in the thermal neutron flux of th Low Intensity Test Reactor and of a graphite reactor. From mass spectrographic analysis of the U^{234} content and assumption of an effective capture cross-section (including epithermal as well as thermal neutron capture) of 8.0 barns for Th^{232}, the effective neutro capture cross-section of Pa^{233} for thermal reactor neutrons was determined to be 140 ± 20 barns.

539.17 : 539.1

THERMAL-NEUTRON CAPTURE IN Mg, Si, P AND S: γ–γ ANGULAR CORRELATION. See Abstr.13530

539.1

13690. THE DETERMINATION OF NEUTRON RESONANCE PARAMETERS OF TUNGSTEN BY THE TRANSMISSION METHOD.
F.W.K.Firk and M.C.Moxon.
Nuclear Phys., Vol. 12, No. 6, 552-62 (Sept. (1), 1959).

The neutron transmission of tungsten from 25 to 200 eV has been measured with a resolution of 0.01 μsec/m using the Harwell 15 MeV linear accelerator and time-of-flight spectrometer. "Area and, in some cases, "shape" analyses of the data were made to determine values of the peak total cross-sections σ_0 and the total widths Γ of twelve resonances. Assuming a constant radiation widt of approximately 0.07 eV the following values were obtained for the spins J of resonances formed in the compound nucleus W^{183} + n: J = 1 for the 27.17 and 46.08 eV resonances and J = 0 for the 47.74, 100.8, 144 and 174 eV resonances. Estimates of the neutron strength functions for the two spin states 0 and 1 are given. Resonances observed at 100.8, 101.5, 103.7, 154.5, 154.5, 155.2, 156.7 a 192 eV have not been resolved previously.

539.1

13691. SPINS AND RADIATION WIDTHS OF THE LOW ENERGY NEUTRON RESONANCES IN TUNGSTEN.
J.R.Waters, J.E.Evans, B.B.Kinsey and G.H.Williams.
Nuclear Phys., Vol. 12, No. 6, 563-78 (Sept. (1), 1959).

Measurements have been made of the parameters of nine low energy neutron resonances in tungsten. The results from neutron transmission, elastic scattering and capture γ-ray experiments were combined to obtain accurate values for the neutron and radiation widths, and, for W^{183}, of the spins of the excited levels. For W^{183} the resonances at 7.62, 27.1, 46.1, 47.7 and 100.8 eV were foun to have spin 1, 1, 1, 0 and 0, respectively. The average value for the radiation widths for the levels with spin 0 and spin 1 were the same within the experimental error. For the three tungsten isotop 182, 183 and 186 the average radiation widths were 50 ± 4 MeV. 73 ± 4 MeV and 45 ± 6 MeV, respectively. These values do not

ee with the observation that the average radiation widths are ghly proportional to the fourth power of the binding energy.

539.17

92. NUCLEAR ABSORPTION CROSS SECTIONS FOR 3.6 BeV JTRONS. P.H.Barrett.
s. Rev., Vol. 114, No. 5, 1374-5 (June 1, 1959).
The absorption cross-section for Pb, Cu, and Al have been asured by means of poor-geometry transmission measurements. neutrons were produced by bombarding a 1 in. thick polyethyl- target with 6.2 BeV protons in the Bevatron. Neutron detection accomplished by measuring the density of stars in nuclear ılsion. These measurements gave for the absorption cross- tions for Pb, Cu, and Al 1930 ±300 mb, 704 ± 140 mb, 430 ± 56 . An absorption mean free path in emulsion of $\lambda = 50 \pm 10$ cm obtained. The source strength of the neutrons was calculated be 0.19 neutron steradian^{-1} proton^{-1} striking the target. By paring the multiplicity of mesons produced in nuclear inter- ions by the neutron beam and by protons of known energy the rage energy of 3.6 ± 0.7 BeV was obtained for the neutron beam.

539.17

93. SCATTERING OF HIGH-ENERGY NEUTRONS BY He^4.
V.Bonner, F.W.Prosser, Jr and J.Slattery.
ys. Rev., Vol. 115, No. 2, 398-400 (July 15, 1959).
The scattering was investigated for neutrons with energies of m 16 to 23.4 MeV, using a helium-filled ionization chamber. A nounced resonance was found at a neutron energy of 15 ± 0.12 MeV. This resonance corresponds to an excitation rgy in He^5 of 16.72 ± 0.10 MeV which is the same excitation rgy as that obtained for the maximum in the $T(d,n)He^4$ cross- tion. The neutron scattering experiments indicate that the level He^5 has a width of about 100 keV which is much narrower than the und state of He^5. This state in He^5 probably has angular momen- n and parity of $\frac{3}{2}+$ and is made up of two neutrons and a proton in S shell and one proton and one neutron in the P shell. Such a nfiguration would explain the large deuteron reduced width of the d,n)He^4 reaction and the small neutron width.

539.17

694. SCATTERING OF NEUTRONS BY ORIENTED NON- HERICAL NUCLEI. G.L.Vysotskii, E.V.Inopin and A.A.Kresnin.
. eksper. teor. Fiz., Vol. 36, No. 2, 574-90 (1959). In Russian.
Scattering of neutrons by oriented nonspherical nuclei is amined. The opaque nuclear model is employed in the calculations the scattering cross-section. It is demonstrated that nonspheric- effects are more appreciable in oriented nuclei than in non- ented nuclei. It is also shown that a noticeable azimuthal asym- try appears in the angular distribution of neutrons scattered on ented nonspherical nuclei.

539.17

695. ABSORPTION OF SLOW π^- MESONS BY NUCLEI.
T.Varfolomeev.
. eksper. teor. Fiz., Vol. 35, No. 2(8), 540-1 (Aug., 1958).
Russian. English translation in: Soviet Physics—JETP (New rk), Vol. 35(8), No. 2, 373-4 (Feb., 1959).
Discusses the specific reaction of the type

$$A + \pi^- \rightarrow B + n,$$

th the residual nucleus in its ground state, or in a slightly cited state. It is concluded that collective interactions between cleons in the nucleus can play an important role in the absorption slow π^- mesons. S.J.St-Lorant

539.17

696. CROSS-SECTION FOR THE FORMATION OF Te^{125m} BY THE γ) REACTION. V.S.Gvozdev and Yu.L.Khazov.
. eksper. teor. Fiz., Vol. 36, No. 2, 632-3 (Feb., 1959). In Russian.
The ratio of the cross-section for the formation of the isomeric te with spin $\frac{11}{2}$, by (n,γ) to the cross-section for the formation the ground state is found to be 6×10^{-3}. J.Lascoux

539.17 : 539.12

697. EMISSION OF ELECTRONS IN THE CAPTURE OF MESONS AND THE RANGE OF THE FERMI INTERACTION.
Jouvet and J.C.Houard.
R.Acad. Sci. (Paris), Vol. 248, No. 23, 3275-7 (June 8, 1959).
In French.
It is argued that the ratio

$$\lambda^2 = \frac{\mu \rightarrow e}{\mu \rightarrow \nu} < 5 \times 10^{-4}$$

in the capture of μ-mesons leads to the hypothesis of a heavy boson of baryon number 1, if the nucleon interaction range exceeds 0.4×10^{-14} cm. In this case the nucleon—neutrino would have an effective cross-section (λ^{-2}) greater than the cross-section for neutrino capture. S.J.St-Lorant

539.17

13698. NEUTRON ASYMMETRY FROM MU CAPTURE IN MAGNESIUM. W.F.Baker and C.Rubbia.
Phys. Rev. Letters, Vol. 3, No. 4, 179-81 (Aug. 15, 1959).
Measurements have been made of the asymmetry with respect to the μ^- spin direction of neutrons emitted after μ^- capture in magnesium. The presence of such an asymmetry would be evidence for parity non-conservation in the process $\mu^- + p \rightarrow n + \nu$. Assuming an angular distribution of the form $1 + \alpha \cos\theta$, the results were as follows: for neutrons of energy > 5.5 MeV, $\alpha = +0.15 \pm 0.11$; for neutron energy > 10 MeV, $\alpha = +0.15 \pm 0.18$; and for neutron energy > 15 MeV, $\alpha = +0.37 \pm 0.28$. These results disagree with calculations by Primakoff, who predicted a negative value of α, possibly as great as 0.4. R.E.Meads

539.17

NUCLEAR REACTIONS DUE TO COSMIC RAYS. See also the Section entitled "COSMIC RAYS".

539.17

13699. FISSION OF NUCLEI OF HEAVY ELEMENTS PRODUCED BY IMPINGING CARBON, NITROGEN AND OXYGEN NUCLEI.
S.M.Polikanov and V.A.Druin.
Zh. eksper. teor. Fiz., Vol. 36, No. 3, 744-7 (1959). In Russian.
The energy dependences of the cross-sections for Bi and U fission induced by accelerated C^{12}, N^{14} and O^{16} nuclei and also the dependences of the Au, Re and Yb fission cross-sections on the N^{14} ion energy are presented. The measurements were performed with an ionization chamber and monochromatic beam from a 150 cm cyclotron. Experimental results pertaining to the measurement of the ranges and angular anisotropy of the U^{238} and Au fission fragments produced by accelerated C^{12} ions are also presented.

539.17

13700. FISSION OF U^{238} INDUCED BY μ^- CAPTURE.
J.Diaz, S.N.Kaplan, B.MacDonald and R.V.Pyle.
Phys. Rev. Letters, Vol. 3, No. 5, 234-5 (Sept. 1, 1959).
μ^- stopped in U^{238} may induce fission in two ways. Non-radiative transition of the μ-mesic atom to the 1s state leads to prompt fission; nuclear capture leads to fission with a lifetime characteristic of μ absorption. Preliminary results of an experiment to determine the relative probabilities indicate that 5.6 ± 2.7% of fissions occur promptly; the others with a lifetime $7.54 \pm 0.55 \times 10^{-8}$ sec.
D.W.L.Sprung

539.17

13701. ANISOTROPIC ANGULAR DISTRIBUTION OF FISSION FRAGMENTS IN ROTATING NUCLEI. G.A.Pik-Pichak.
Zh. eksper. teor. Fiz., Vol. 36, No. 3, 961-2 (March, 1959). In Russian.
The anisotropy coefficient is obtained by expanding work reported previously by the author and by Strutinskii, especially for fusions with one degree of cascade emission of neutrons. Theoretical results are compared with experimental data obtained for α-particle reaction with Pu^{239}, Np^{237}, U^{235} and Ra^{226}. J.K.Skwirzynski

539.17

13702. THE ENERGY SPECTRUM OF FRAGMENTS FROM THE PHOTOFISSION OF U^{238}.
B.S.Kovrigin, M.Ya.Kondrat'ko and K.A.Petrzhak.
Zh. eksper. teor. Fiz., Vol. 36, No. 1, 315-17 (1959). In Russian.
The maximum γ-ray energy used was 12.5 MeV. The most probable energies of the fragments are 55.1 ± 1 MeV and 86.9 ± 1 MeV, for the heavy and light fragments respectively.
W.O.Lock

539.17

13703. ENERGY DISTRIBUTION OF FISSION FRAGMENTS FROM NEUTRON-INDUCED TERNARY FISSION OF URANIUM NUCLEI.
V.N.Dmitriev, L.V.Drapchinskii, K.A.Petrzhak and Yu.F.Romanov.
Dokl. Akad. Nauk SSSR, Vol. 127, No. 3, 531-3 (July 21, 1959).

In Russian.

Recent results are reviewed and it is concluded that for both U^{235} and U^{233} the energy distribution of ternary fission fragments has maxima around 55 and 85 MeV. These maxima are neither so sharp nor so symmetrical as those for binary fission; moreover the minimum does not lie symmetrically between them but is displaced somewhat towards higher energies. J.W.Gardner

539.17

13704. PILE NEUTRON CROSS SECTIONS OF THE HEAVIER PLUTONIUM ISOTOPES.
P.R.Fields, G.L.Pyle, M.G.Inghram, H.Diamond, M.H.Studier and W.M.Manning.
Nuclear Sci. Engng, Vol. 1, No. 1, 62-7 (March, 1956).

The effective pile neutron-capture cross-sections of the heavier Pu isotopes have been measured by irradiations in the Chalk River Reactor (NRX) and in the Materials Testing Reactor. The values in barns for Pu^{240}, Pu^{241}, Pu^{242}, Pu^{243}, Pu^{244}, and Pu^{245} were found to be: 530 ± 50, 390 ± 80, 30 ± 10, 170 ± 90, 1.5 ± 0.3, and 260 ± 145, respectively. In addition, a thermal neutron absorption cross-section of 1450 ± 250 barns was found for Pu^{241} and a thermal neutron fission cross-section of 1060 ± 210 barns for Pu^{241}. Using these cross-sections and an assumed flux of 3×10^{14} cm^{-2} sec^{-1}, curves were calculated and plotted showing the variation in composition of plutonium as a function of integrated flux.

539.17

13705. CALCULATION OF NEUTRON RADIATIVE CAPTURE CROSS SECTIONS. L.Dresner.
Nuclear Sci. Engng, Vol. 1, No. 2, 103-7 (May, 1956).

Several methods of calculating these are compared, and numerical results are given for U^{238}. The importance of neutron angular momenta higher than zero is found to be large at quite low energies.

539.17

13706. AN EFFECTIVE CAPTURE CROSS SECTION OF Np^{239} FOR THERMAL REACTOR NEUTRONS.
J.Halperin, R.W.Stoughton, C.M.Stevens, D.E.Ferguson and D.C.Overholt.
Nuclear Sci. Engng, Vol. 1, No. 2, 108-11 (May, 1956).

Depleted uranium was irradiated in the thermal neutron flux of the Low Intensity Test Reactor at Oak Ridge National Laboratory. From mass spectrographic analysis of Pu^{240} and from chemical determination of Pu content, the effective capture cross-section (including both thermal and epithermal neutron capture) was determined for Np^{239} to be 80 ± 15 barns.

539.17

13707. THE EFFECTIVE RESONANCE INTEGRALS OF U-238 AND TH-232. L.Dresner.
Nuclear Sci. Engng, Vol. 1, No. 1, 68-79 (March, 1956).

Numerical calculations performed on the ORACLE have made possible exact inclusion of the effect of Doppler broadening of resonance lines in the calculation of resonance absorption integrals. The effective resonance integrals of U^{238} and Th^{232} have been calculated as functions of the scattering cross-section per absorbing nucleus for 0° and 300°K. Agreement of the calculated (300°K) and experimental resonance integrals is excellent for U^{238} and good for Th^{232}, except in the case of pure ThO_2 where a discrepancy is noted.

539.17

13708. DELAYED NEUTRON YIELDS IN Pu, U-233, U-238, AND Th RELATIVE TO YIELD IN U-235.
G.S.Brunson, E.N.Pettitt and R.D.McCurdy.
Nuclear Sci. Engng, Vol. 1, No. 2, 174-84 (May, 1956).

Delayed neutron studies have been made in the Argonne Experimental Breeder Reactor, using a conventional sample transfer system and a neutron counter comprising BF_3 tubes in a graphite geometry. Samples of Th, U^{233}, U^{235}, U^{238}, and Pu were irradiated in a fast flux; samples of U^{233}, U^{235}, and Pu in a thermal flux. The ratio of the delayed neutron yield per fission (based on the longest four periods) to the delayed neutron yield per fast fission of U^{235} was determined as: for fast fission of U^{235}, 0.414 ± 7.5%; for fast fission of Pu, 0.405 ± 7.5%; for fast fission of Th, 3.09 ± 17%; for fast fission of U^{238}, 2.23 ± 7.5%. The ratio of fast fission to thermal fission delayed neutron yields was not significantly different from unity for all samples except Pu, where the ratio of thermal to fast fission yields was 0.888 ± 6%. This latter is believed to be primarily attributable to the 5% fraction of Pu^{240} in the sample.

539.

13709. ON THE ANGULAR ANISOTROPY OF THE FRAGMENTS FROM THE FISSION OF Am^{241} BY NEUTRONS OF 14.7 MeV.
A.N.Protopopov, I.A.Baranov and V.P.Eismont.
Zh. eksper. teor. Fiz., Vol. 36, No. 3, 920-1 (March 1959).
In Russian.

The degree of anisotropy is found to be 1.08 ± 0.06. This see to confirm the general trend that the anisotropy decreases with increasing values of Z^2/A. J.Lasco

539.17 : 539.1

13710. GAMMA-RAYS ACCOMPANYING THE FISSION OF U^{235} B NEUTRONS WITH ENERGIES 2.8 and 14.7 MeV.
A.N.Protopopov and B.M.Shiryaev.
Zh. eksper. teor. Fiz., Vol. 36, No. 3, 954-5 (1959). In Russian.

An extension of previous work on U^{235} (Abstr. 8358 of 1958). The mean total gamma-ray energy is found to be within ± 15% of that from the thermal fission of U^{235}, for both the neutron energies studied. W.O.Lo

539.17 : 523.8

13711. CARBON THERMONUCLEAR REACTIONS AND THE FORMATION OF HEAVY ELEMENTS. A.G.W.Cameron.
Astrophys. J., Vol. 130, No. 2, 429-51 (Sept., 1959).

When helium is consumed at a high rate of energy generation in massive stars and in shell sources of less massive stars, the principal product is C^{12}. Following helium exhaustion, the next source of energy generation involves carbon thermonuclear reactions. In these reactions both protons and alpha-particles are produced. In the earlier stages of carbon-burning, the protons are captured by C^{12}, forming C^{13}, and the alpha-particles react wi the C^{13} to produce neutrons. These neutrons are captured on a sl time scale and can produce heavy elements, provided that the number of protons is comparable to the number of alpha-particles as is estimated to be the case. The heavy-element abundances produced from material consisting initially of pure hydrogen are approximately normal for population I stars. However, contamina tion of the initial material by comparatively small amounts of intermediate elements results in heavy-element overabundance factors of several thousand. This process can take place in unmi stellar material and does not suffer from the uncertainties of the Ne^{21} hypothesis. It may be the principal source in nature of produ formed by neutron capture on a slow time scale.

539.

13712. A DIRECT COMPARISON OF SOME NUCLEAR PROPERTIES OF U-233 AND U-235. J.T.Thomas, J.K.Fox and D.Callihan
Nuclear Sci. Engng, Vol. 1, No. 1, 20-32 (March, 1956).

Uses data obtained in a series of critical experiments. Aquec solutions of uranyl oxyfluoride containing uranium enriched to abo 90% in each of the two isotopes have been made critical in water-reflected spherical reactors having diameters of 26.4 and 32.0 cm Assuming the reported nuclear constants for U^{235} are reliably kno and assuming equality of the neutron leakage spectra of U^{233} and U for the same water-reflected critical sphere, the value of $\eta(U^{233})$ a 0.026 eV was determined to be 2.31 ± 0.03. The critical masses f the two isotopes in these systems have been measured over the temperature range from 20° to 100°C; corresponding values of the reactivity temperature coefficient are reported. Delayed neutron yields for the two isotopes were compared by noting the periods re sulting from the withdrawal of a boron poison from the critical spheres. It is shown that the yield from U^{233} is about one-third th from U^{235}, in agreement with other determinations.

539.1

13713. ALPR. ARGONNE LOW POWER REACTOR.
Nucleonics, Vol. 17, No. 2, chart facing p. 54 (Feb., 1959).

Nucleonics reactor file No. 7. ALPR is a direct cycle boiling light water reactor, designed to be easily transportable in cargo aircraft. The core contains 14 kg of U^{235} in plate type fuel element and generates 3 MW of heat. The output is 300 kW of electricity plus 400 kW of space heat. R.D.Smi

539.1

13714. TOPSY, A REMOTELY CONTROLLED CRITICAL ASSEMBLY MACHINE. R.H.White.
Nuclear Sci. Engng, Vol. 1, No. 1, 53-61 (March, 1956).

A remotely operated facility for the study of reacting metal assemblies with thick reflectors is described. Design of the assembly machine permits adaptation to nuclear components of

ous materials and geometries. Data resulting from experi-
al programmes on the behaviour of reflected critical assemb-
can be applied to fast reactor problems.

539.17

5. THE NUMERICAL SOLUTION OF THE TWO-GROUP
FUSION-EQUATION FOR MULTILAYER REACTORS WITH THE
P OF ELECTRONIC DIGITAL-COMPUTERS.
mbser and E.Fischer.
nkernenergie, Vol. 4, No. 5, 186-9 (May, 1959). In German.
The neutron flux distribution in a critical thermal reactor is
factorily described by the 2-group diffusion-equations. The
ron fluxes Φ_f and Φ_s can be analytically expressed as linear
inations of Bessel functions. The coefficients can be calculated
linear equations with the help of a computor. However, to do
calculation for reactors with more than 3 layers or more than
utron groups would exceed the capacity of an IBM 650. There-
a finite difference method is described for numerically integ-
g the diffusion equations and which can handle large numbers
terpolation points and hence layers. D.H.Lord

539.17

6. A CRITERION FOR NONLINEAR STABILITY OF NUCLEAR
CTORS. H.B.Smets.
. Acad. Roy. Belgique Cl. Sci., Vol. 45, No. 2, 102-7 (1959).
rench.
The reactivity k of a reactor is assumed to be given by:

$$k = k_0(t) - \int_0^\infty K(u)[n(t-u) - n_0]du.$$

demonstrated that for a homogeneous reactor with stationary
it will be stable after an instantaneous perturbance of its
tivity, as long as the real part of the Fourier transform of the
el K(u) is not negative. D.H.Lord

539.17

7. ESTIMATION OF DOPPLER EFFECT IN FAST REACTORS.
eshbach, G.Goertzel and H.Yamauchi.
ear Sci.Engng, Vol. 1, No. 1, Vol. 1, 4-19 (March, 1956).
The detailed variation with energy of that part of the neutron
s-section of an element which shows resonance behaviour is
perature dependent. This dependence, the Doppler effect, arises
the temperature variation of neutron—nuclear relative velocity
ribution. An effective cross-section (dependent on reactor com-
tion) useful in reactor calculations in place of the rapidly fluctu-
actual cross-section is defined. Knowledge of the variation of
effective cross-section with material temperature is needed for
ulation of the temperature coefficient of reactivity. Unfortun-
, resolution of present measuring equipment does not permit
ciently accurate measurement of cross-sections in the energy
e of interest in fast reactors (100 keV to several MeV) for
pler effect calculation nor are direct measurements in this energy
e available at present. To estimate Doppler effect, it has been
med that in any energy range containing many resonances the
al cross-section is equivalent, as far as reactor behaviour is
erned, to a cross-section constructed by selecting spacings be-
n neighbouring resonances and other resonance parameters in-
ndently from probability distributions of these parameters. In
manner, temperature coefficients may be calculated in terms of
sured cross-sections and various statistical parameters of the
ability distributions, the parameters being estimated from low-
gy data on actual resonances. In applying the low-energy data to
nergy ranges of interest, the predictions of the statistical model
e nucleus, as developed by Weisskopf and others, are employed.

539.17

8. AN UNREFLECTED [SPHERICAL] U-235 CRITICAL
EMBLY. R.E.Peterson and G.A.Newby.
ear Sci. Engng, Vol. 1, No. 2, 112-25 (May, 1956).
A remotely controlled mechanical system is used to assemble
ritical components of the sphere, and reactivity is adjusted
U^{235} control rods. The maximum power level during sustained
ation is about 1 kW. Investigations with the assembly include
ies of the neutron spectrum, observation of the changes of re-
ity produced by inserting foreign materials into the assembly,
determination of parameters such as the temperature coefficient
eactivity. In addition, experiments at reactivities above prompt
cal have been carried out. The assembly has also been used as
urce of short, high-intensity bursts of neutrons in the study of
yed neutrons following fission.

539.17

13719. ADJUSTMENT OF THE NEUTRON SPECTRUM IN THE ARGONAUT REACTOR. H.Märkl.
Nukleonik, Vol. 1, No. 7, 251-9 (Aug., 1959). In German.

A section of the SNDR (Siemens-natural uranium-D_2O-reactor) can be investigated by placing it at the centre of an Argonaut reactor. For the experimental results obtained to apply, it is necessary for the neutron spectrum in the SNDR insert to be adjusted so that it is equivalent to the characteristic spectrum of the SNDR. It is shown theoretically that by introducing a 3.1 cm thick H_2O layer or a 7.35 cm D_2O layer between the Argonaut core and the insert, the overlapping of the hard Argonaut spectrum into the insert can be eliminated. It is further demonstrated, by two-group calculations of critical mass and flux distribution in an Argonaut with enriched fuel at the front of the insert, that the flux curvature in the segment can be adjusted to that in the SNDR. D.H.Lord

539.17

13720. ON THE THEORY OF A MEASURING METHOD FOR THE RESONANCE TRANSITION PROBABILITY. W.Oldekop.
Nukleonik, Vol. 1, No. 7, 259-65 (Aug., 1959). In German.

Some of the assumptions in the methods of Egiazarov and Klein to find this probability are no longer fulfilled in a small lattice embedded in a research reactor. A better relation between (1-p)/p and the U^{238} capture ratio is derived. This contains correction terms obtained from two-group theory. A calculation based on an Argonaut reactor with a natural uranium-D_2O insert whose spectrum has been corrected by an H_2O layer (see preceding abstract) shows that p can be determined to ±0.5%, if the U^{238} capture ratio is measured to ±3% and if the spectrum correction has been obtained to ±3%. The U^{238} capture ratio is determined by measuring the activities of the fission products in a U^{238} foil, placed in the lattice, once with a Cd-coating and once without. D.H.Lord

539.17

13721. ON THE THEORY OF THE REACTIVITY CONTRIBUTION BY CAVITIES AND A METHOD FOR THE DETERMINATION OF k_∞. W.Humbach and W.Oldekop.
Nukleonik, Vol. 1, No. 7, 265-72 (Aug., 1959). In German.

If, for example, a seven-cell natural uranium-D_2O lattice is embedded in an Argonaut reactor with a cavity at its centre and either the D_2O is poisoned or the U^{235} content is reduced until the reactivity of the whole system is restored to its unperturbed value, then, as the cavity has a $k_\infty = 1$, k_∞ for the original lattice can be obtained from the "poisoning" or U^{235} reduction, with appropriate corrections. To facilitate this, the reactivity ρ produced in a critical system by the introduction of a cavity is calculated by perturbation theory using the p_1-approximation with multi-group theory. The dependence between the reactivity contribution of the cavity and the removed lattice is discussed. D.H.Lord

539.17 : 778.34

SCOPE OF NUCLEAR EMULSIONS IN THE SPECTRAL ANALYSIS OF NEUTRONS FROM REACTORS. See Abstr. 14013.

539.17

13722. ENERGY AND ANGULAR DISTRIBUTIONS IN DIFFRACTIONAL DISINTEGRATION PROCESSES.
I.I.Ivanchik and V.S.Popov.
Zh. eksper. teor. Fiz., Vol. 36, No. 2, 499-504 (1959). In Russian.

The energy and angular distributions are obtained for particles produced in diffractional disintegration of a weakly bound quantum-mechanical system (deuteron, etc.). The energy distributions are practically identical with those observed in stripping, whereas the angular distributions are appreciably different. A simple physical explanation of this difference can be proposed and it may be of importance in interpreting the experimental data.

ATOMS

539.18

13723. CALCULATION OF POLARIZABILITIES. I. FREE ATOMS. P.Gombás.
Acta phys. Hungar., Vol. 10, No. 1, 101-10 (1959). In German.

The polarizability of the free atoms of Ne, A, Kr and Xe is calculated using a perturbation method and the statistical model of a previous paper [Gombás, Acta phys. Hungar., Vol. 8, No. 3, 305-14

(1958)]. Good agreement with experiment is obtained for Kr and Xe. For the lighter atoms of Ne and A, the calculated values are much too high, but good agreement can be obtained if the statistical electron density is replaced by the wave mechanical Hartree–Fock density. W.A.Hepner

539.18

13724. RECENT WORK WITH THE TRANSURANIUM ELEMENTS. G.T.Seaborg.
Proc. Nat. Acad. Sci. U.S.A., Vol. 45, No. 4, 471-82 (April, 1959).

Review of present knowledge of the transuranium elements. Elements of atomic number to 102 have been prepared and identified and some of their properties determined. The properties of elements from 103 to 110 can be predicted and possible methods of synthesis are suggested. A.E.I. Research Laboratory

539.18

13725. APPROXIMATE WAVE FUNCTIONS OF Pb^{+++} BY THE METHOD OF SELF-CONSISTENT FIELD WITHOUT EXCHANGE. J.F.Hart and B.H.Worsley.
Canad. J. Phys., Vol. 37, No. 9, 983-8 (Sept., 1959).

The FERUT programme previously described (Abstr. 1989 of 1958) for calculating Hartree–Fock wave functions by the method of the self-consistent field was adapted to the configuration Pb^{+++}. Although the exchange factors were omitted, the programme was extended beyond its original scope in other respects, and an assessment of the difficulties so encountered is made. It might be noted, however, that, except in the case of the 4f wave-function, it was possible to begin all the integrations at a common point. Initial estimates were made from the Douglas, Hartree, and Runciman results for thallium. The estimates for the core functions were not assumed to be satisfactory. The errors in the final wave-functions are considered to be no more than one or two units in the second decimal digit.

539.18

13726. CALCULATION OF GAUNT FACTORS FOR FREE–FREE TRANSITIONS NEAR POSITIVE IONS. I.P.Grant.
Monthly Not. Roy. Astron. Soc., Vol. 118, No. 3, 241-57 (1958).

A discussion is given of methods which may be used to compute Gaunt factors for free–free transitions in the neighbourhood of any positive ion. The equivalence of the formulae of Sommerfeld and of Menzel and Pekeris for hydrogen-like systems is demonstrated, and a number of approximations to them discussed. It is shown that the rapid computation of numerical values of monochromatic Gaunt factors for any electron velocity is assured by means of an extensive table of values supplemented by simple asymptotic expansions. The effect of screening on Gaunt factors is estimated for long wavelengths by a simple formula derived in the Born approximation with the aid of an atomic potential function of the form $r^{-1}\Sigma\alpha_n \exp(-\beta_n r)$. The method is illustrated by examples in which Thomas–Fermi and self-consistent potential functions are expressed in this form. A simple procedure for calculating Gaunt factors averaged over a Maxwellian velocity distribution is given using a quadrature formula based on evaluation of the integrand at the zeros of Laguerre polynomials. Three integration points are found to be adequate to give accuracy comparable to that attained by more elaborate methods.

539.18

13727. NUCLEAR MAGNETIC SHIELDING OF A HYDROGEN ATOM IN AN ELECTRIC FIELD. T.W.Marshall and J.A.Pople.
Molecular Phys., Vol. 1, No. 3, 199-202 (July, 1958).

The nuclear magnetic screening constant of a hydrogen atom in a uniform electric field is calculated, neglecting any effect of electron spin. The screening is found to be reduced by the electric field for all directions of the applied magnetic field, the reduction being greatest if the two fields are perpendicular.

539.18

13728. TOTAL PHOTOELECTRIC CROSS SECTIONS OF COPPER, MOLYBDENUM, SILVER, TANTALUM, AND GOLD AT 662 keV. W.F.Titus.
Phys. Rev., Vol. 115, No. 2, 351-6 (July 15, 1959).

The total photoelectric cross-sections of copper, molybdenum, silver, tantalum, and gold were measured at 662 keV. A highly collimated beam of gammas from a Cs^{137} source impinged upon a thin disk of a target material. Photoelectrons from a target were detected by a plastic scintillator subtending very nearly 4π steradians. Pulse-height analysis permitted partial resolution of photoelectric and Compton events. After subtraction of unresolved Compton events and correction for coherent scattering effects, the cross-sections were found to be 0.125 ± 0.009, 0.700 ± 0.016, 1.198 ± 0.028, 8.55 ± 0.14, and 11.62 ± 0.16 barns, respectively, in satisfactory agreement with theory.

539.1

13729. GROUND STATE OF THE HELIUM ATOM. II. T.Kinoshita.
Phys. Rev., Vol. 115, No. 2, 366-74 (July 15, 1959).

For Pt I see Abstr. 5574 (1957). A further attempt is made to improve the theoretical prediction of the ground state energy of atomic helium. The nonrelativistic is treated by the variational method of Stevenson and Crawford which is useful for improving the lower bound for the ground state energy. Linear combinations of up to 80 terms of generalized Hylleraas type are employed in the numerical computation. The best trial function gives −2.9037237 atomic units as an upper bound and −2.9037467 atomic units as a lower bound for the ground state energy. It is estimated from the calculated results that the exact nonrelativistic energy of He ground state will be found in the neighbourhood of −2.9037247 atomic units. Rigorous formulae are derived which can be used for calculating the upper limits to the errors in the expectation values of mass polarization and relativis corrections. Although these formulae give very broad limits of e they are useful in estimating the order of magnitude of actual err in a semiempirical manner. With mass polarization and relativis corrections as well as electrodynamical corrections, the theoretic ionization potential becomes 198310.77 cm^{-1} which is in good agre ment with the latest observed value $198310.8_2 \pm 0.15$ cm^{-1}.

539.

13730. A PERTURBATION CALCULATION OF PROPERTIES OF THE HELIUM ISO-ELECTRONIC SEQUENCE. A.Dalgarno and A.L.Stewart.
Proc. Roy. Soc. A, Vol. 247, 245-59 (Sept. 16, 1958).

Perturbation methods are employed to calculate the magnetic susceptibilities and the dipole polarizabilities of the ground states the members of the helium iso-electronic sequences and also the mass polarization, relativistic and radiative corrections to their energies, the results being obtained as power series in the invers of the nuclear charges. The calculations are prefaced by a brief summary of the equations of perturbation theory applicable to the c when the unperturbed wave-function is known only approximately.

539.18 : 535.3

ENERGY LEVELS OF NEUTRAL AND SINGLY IONIZED PHOS PHORUS. See Abstr. 13155

539.

13731. CONSEQUENCES OF ATOMIC CONVERSION FOR THE INTERPRETATION OF EXPERIMENTS ON THE SPIN-DEPENDE OF MUON ABSORPTION. V.L.Telegdi.
Phys. Rev. Letters, Vol. 3, No. 1, 59-61 (July 1, 1959).

The spin dependence of muon absorption can affect the decay rate of μ-mesonic atoms. The modifications of this effect due to atomic conversion processes are studied. R.J.N.Phill

539.

13732. SUPPRESSION OF P-STATE CAPTURE IN (K^-,p) ATOM T.B.Day, G.A.Snow and J.Sucher.
Phys. Rev. Letters, Vol. 3, No. 1, 61-4 (July 1, 1959).

It is shown that K^- absorption at rest in liquid hydrogen is almost always from an S state. K-atomic P states are rapidly depopulated by Stark transitions in the fields of neighbouring prot R.J.N.Phill

539.1

13733. DE-EXCITATION OF μ-MESONIC ATOMS. N.A.Krall and E.Gerjuoy.
Phys. Rev. Letters, Vol. 3, No. 3, 142-4 (Aug. 1, 1959).

An estimate is made of the rate of collisional de-excitation o a μ-mesonic atom from the 2p to the 2s level. This is considerab larger than similar estimates of the 2p to 1s transition, but it is probably not rapid enough to explain the K-series radiation data found experimentally for μ-mesonic atoms. The calculated high rate of collisional de-excitation between levels with the same principal quantum number modifies previous estimates of the percentage of μ-mesonic atoms which finally reach the 2p or 2s states. E.J.Squir

539.18

4. DEPOLARIZATION OF THE μ^--MESON IN MESIC ATOM NSITIONS. V.A.Dzhrbashyan.
eksper. teor. Fiz., Vol. 36, No. 1, 277-82 (1959). In Russian.
A method is proposed for calculating the depolarization. The nation of the expected μ^--meson depolarization is in good agree- t with available experimental data.

539.18 : 539.17 : 539.14

RELATIVE ABUNDANCE OF Gd ISOTOPES. See Abstr. 13600

539.18 : 535.338.3

5. ON THE SHAPE OF THE LINE PROFILE IN AN ATOMIC M. F.A.Korolev, B.A.Kozlov and A.I.Odintsov.
ka i Spektrosk., Vol. 6, No. 5, 576-9 (May, 1959). In Russian.
A general expression is obtained for the profile of a spectral produced in an atomic beam e.g. by excitation with electrons. effect of the slit width of a furnace used to produce the atomic n is discussed and formulae reported earlier are shown to be icular cases of the expression given here. A.Tybulewicz

539.18 : 539.2

6. CRYSTAL ATOM SPACING AND THE WAVELENGTH OF INCIDENT ATOM BEAM. R.E.Davidson.
s. Rev., Vol. 115, No. 3, 570-4 (Aug. 1, 1959).
A beam of atoms is assumed to be incident on a crystal, and a tain aspect of the energy exchange is investigated insofar as is sible without elaborate experiments or calculations. The inter- on potential is assumed to be that for helium and lithium fluoride is known from other sources. By taking account of thermal ion of the crystal atoms tangentially to the surface of the crystal, deduced that the probability that the beam will give up energy ne surface becomes relatively large when the de Broglie wave- th of the tangential component of beam moment is decreased to same order of magnitude as the spacing of atoms in the crystal.

539.18 : 535.33.03

A HIGH-INTENSITY ATOMIC-BEAM LIGHT SOURCE. See tr. 13140

539.18

7. CLASSICAL THEORY OF ELECTRONIC AND IONIC IN- STIC COLLISIONS. M.Gryziński.
s. Rev., Vol. 115, No. 2, 374-83 (July 15, 1959).
A classical theory of inelastic atomic collisions is given. It is wn that inelastic scattering, ionization, excitation, and other ractions between charged particles and atoms are due to the lomb interaction with atomic electrons and depend in a first ap- ximation on their binding energy and momentum and distribution. cross-sections can easily be calculated by means of differential ss-sections $\sigma(\Delta E)$ and $\sigma(\Delta E,\theta)$ derived in the binary encounter roximation. Numerical calculations were made for several cases are in very good agreement with the experimental results.

539.18 : 535.14

ELECTROMAGNETIC INTERACTIONS OF ATOMS. Abstr. 13132

MOLECULES

539.19

8. ON THE AVERAGE ENERGIES OF MOLECULAR IONS. .Stevenson.
iation Research, Vol. 10, No. 6, 610-21 (June, 1959).
The average excitation energy with which molecular ions are med in electron-impact ionization is calculated by two indepen- t methods, one using the quasi-equilibrium rate theory of the gin of mass spectra, and the other using the linear extrapolation earance potentials. These calculations were done for various rocarbons, and the results of the two methods agree well, ding to substantiate the validity of the first approach, and of the ults obtained. J.Hawgood

539.19

9. CALCULATED VIBRATIONAL FREQUENCIES FOR ^{18} AND D_2O^{18}. G.Gompertz and W.J.Orville-Thomas.
J. phys. Chem., Vol. 63, No. 8, 1331-2 (Aug., 1959).
These are predicted from data for the O^{18} case, using the complete quadratic potential function. J.Hawgood

539.19

13740. A NORMAL COORDINATE TREATMENT OF THE PLANE SYMMETRICAL XY_4 MOLECULE. C.W.F.T.Pistorius.
Molecular Phys., Vol. 1, No. 3, 295-300 (July, 1958).
The secular equations for the various irreducible representations of the plane XY_4 molecule (symmetry point group D_{4h}) are deduced by means of Wilson's F–G matrix method, using the most general harmonic force field. The equations for the case of the simple valence field force are also given.

539.19

13741. THEORY OF THE RENNER EFFECT IN THE NH_2 RADICAL. J.A.Pople and H.C.Longuet-Higgins.
Molecular Phys., Vol. 1, No. 4, 372-83 (Oct., 1958).
The observations of Dressler and Ramsay (Abstr. 3418 of 1958) on the vibronic absorption spectrum of the NH_2 radical are interpreted in terms of the Renner effect. The use of a perturbation method leads to frequency predictions which are in good accord with experiment and confirm the view of these authors that the absorption band is associated with transitions between the components of an electronic Π state which are widely separated by electronic–vibrational interaction.

539.19

13742. AN IMPROVED METHOD OF CALCULATING PARTIAL DERIVATIVES OF NORMAL VIBRATIONAL FREQUENCIES OF POLYATOMIC MOLECULES WITH RESPECT TO VARIOUS PARAMETERS. L.S.Mayants.
Optika i Spektrosk., Vol. 5, No. 4, 378-83 (1958). In Russian.
Partial derivatives of the frequency of normal vibrations with respect to the force constants and other molecular parameters are defined and a simple method of calculating these derivatives and the form of normal vibrations is described. A.Tybulewicz

539.19

13743. APPLICATION OF THE SPECTROSCOPIC-MASS METHOD TO DETERMINATION OF THE VIBRATIONAL FREQUENCIES OF ISOTOPIC MOLECULES.
N.K.Morozova and V.P.Morozov.
Optika i Spektrosk., Vol. 5, No. 5, 535-41 (1958). In Russian.
Hemptinue and Manneback's method of spectroscopic masses (1939) is applied to determination of fundamental frequencies of XY_2 and XY_3 molecules, where Y = H or D. From the results obtained improved values of certain fundamental frequencies of the D_2S, HDS, ND_3 and PD_3 molecules are deduced. A.Tybulewicz

539.19

13744. ASYMPTOTIC DEVELOPMENT OF THE PARTIAL FUNCTION OF A RIGID SYMMETRICAL TOP. H.K.Wimmel.
Z. Naturforsch., Vol. 14a, No. 8, 738-49 (Aug., 1959). In German.
See Abstr. 1553 of 1933. This development enables the numerical evaluation of the partial function of the rigid symmetrical top itself and of the corresponding rotation part of thermodynamical functions to be carried out with sufficient accuracy over a wide temperature range. In the case of all molecules of the point-symmetry groups C_p, C_{pv}, C_{ph}, D_p, D_{pd}, D_{ph} (where p = 2, 3, 4, 6) the statistical weights of the rotation states are allowed for; it is found that it is only the mean value of the statistical weights that enters as factor into the development in question; hence the asymptotic expressions for the thermodynamical functions become independent of the molecule symmetry and of the nuclear spin. Modified Euler summation formulae are used for obtaining the results. F.Lachman

539.19

13745. GROUND STATE AND LOW EXCITED STATES OF THE NEGATIVE HYDROGEN MOLECULE ION. I.Fischer-Hjalmars.
Ark. Fys., Vol. 16, Paper 4, 33-55 (1959).
The potential curves of the lowest states of H_2^- were calculated in the range of R-values from 1 to 10 A. The following states, arranged according to increasing value of the minimum energy, are found to correspond to discrete energy levels: $^2\Sigma_u^+$, $^2\Pi_u$, $^2\Sigma_g^+$, $^2\Sigma_u^+$ and $^4\Sigma_u^+$. The minimum of the potential curve for the ground state is found at R = 1.65 A and E = 1.1057 A corresponding to a dissociation energy D_e = 59 kcal/mole. H_2^- is thus found to be comparatively stable towards dissociation into H and H^-. Moreover, the

electron affinity of H_2 is found to be $EA(H_2) = -0.28$ eV = −6.4 kcal/mole. The bearing of these results on the possible reactions between electrons and H_2 molecules is briefly discussed.

539.19

13746. EXCITATION OF π ELECTRONS IN BENZENE BY FAST ELECTRON ACCORDING TO FE MODEL. M.Inokuti.
J. Phys. Soc. Japan, Vol. 13, No. 5, 537 (May, 1958).

It is shown by calculation that the cross-section for excitation of π-electrons to the lowest excited levels in benzene is very large. Exchange collisions have been neglected and it is pointed out that the corresponding excited levels, being singlets, may contribute little to the initiation of secondary processes leading to overall radiation effects. The interpretation of the radiation-insensitivity of benzene in terms of these results is therefore only qualitative.
R.A.Ballinger

539.19

13747. THE π-ELECTRON SPECTRA OF THE BENZENE N-HETEROCYCLICS. J.N.Murrell.
Molecular Phys., Vol. 1, No. 4, 384-90 (Oct., 1958).

The π-electron spectra of the nitrogen heterocyclics are discussed on the basis of a perturbation applied to the spectra of the corresponding aromatic hydrocarbons. The frequency of the first $\pi \rightarrow \pi$ band in pyridine is the same as that of the corresponding band in benzene, because of the accidental cancellation of a first-order blue shift by a second-order red shift. The first- and second-order shifts are related to two perturbation parameters, and these are obtained from experiment by examining the spectra of the benzene heterocyclics. These parameters can then be satisfactorily related to one another by assuming a perturbation field of the form $\exp(-2\eta r)/r$ and by allowing for the C—N bond being shorter than the C—C bond in benzene.

539.19

13748. A NEW METHOD OF SEMI-THEORETICAL CALCULATION OF ELECTRON INTEGRALS. A.Julg.
J. Chim. phys., Vol. 56, No. 3, 235-9 (March, 1959). In French.

See Abstr. 5116 (1959). The method for the calculation of monocentric and dicentric Coulomb integrals, suggested in the previous paper, is studied again taking into account the energy of electron correlation. This results in the possibility of calculating the core integrals in atoms and molecules. The method has been used with success in the case of butadiene. F.Lachman

539.19

13749. σ—π INTERACTION AND PROTON HYPERFINE INTERACTION. S.Aono.
Progr. theor. Phys., Vol. 21, No. 6, 779-91 (June, 1959).

Proton hyperfine interactions in aromatic radicals and aromatic ions are calculated by the molecular orbital method, and the basis of the semi-empirical equation, $a_N = Q\rho$, is clarified; a_N is the splitting constant referred to proton N, ρ is the unpaired electron density at the carbon atom adjacent to the proton N, and Q is the semi-empirical constant assumed to be the same for all CH bonds. Two essential approximations in this treatment are: (a) the singlet—triplet excitation energies in σ orbitals are replaced by an averaged value ΔE_{AV}; (b) all σ orbitals containing CH bonds are transformed into $\bar{\sigma}$ orbitals which are strongly localized to each CH bond, and are approximated to be CH bond orbitals between the 1s hydrogen atomic orbitals and the carbon sp_2 hybrid orbitals. It is shown that the calculation of proton hyperfine splittings in the hypothetical CH fragment leads to the same results as in the case of the entire set of the aromatic system. The above two approximations are shown to be reasonable for aromatic systems. The calculated value of Q is −22.2 gauss, which is quite close to the semi-empirical value −22.5 gauss.

539.19 : 538.27

HYPERCONJUGATION IN THE ELECTRON RESONANCE SPECTRA OF FREE RADICALS. See Abstr. 13464

539.19

13750. H^1—P^{31} SPIN COUPLING IN TRIALKYL PHOSPHATES. R.C.Axtmann, W.E.Shuler and J.H.Eberly.
J.chem. Phys., Vol. 31, No. 3, 850-1 (Sept., 1959).

The indirect spin—spin coupling between the P^{31} nucleus and the protons of the adjacent methylene groups is found to decrease as the number of methyl groups in the alkyl chains increases.
E.F.W.Seymour

539

13751. NUCLEAR SPIN COUPLING BY ELECTRON ORBITAL POLARIZATION. J.A.Pople.
Molecular Phys., Vol. 1, No. 3, 216-22 (July, 1958).

A theory is presented of the coupling of nuclear spins in a molecule by the induction of electronic orbital currents. An approximate expression for the contribution of this effect to the total coupling constant is derived in terms of the anisotropy of the magnetic screening of the nuclei involved. The theory is applied to some coupling constants involving fluorine nuclei, for which the electron orbital contribution is found to be an appreciable but not dominant part. It can have either sign, but is usually positive.

539

13752. ON THE NUCLEAR MAGNETIC SHIELDING IN THE HYDROGEN MOLECULE. H.F.Hameka.
Molecular Phys., Vol. 1, No. 3, 203-15 (July, 1958).

A simplified method is discussed for calculations of proton shielding in molecules by using wave-functions which are constructed from gauge invariant atomic orbitals. The method is applied to the hydrogen molecule by means of a simple LCAO MO description. The computed total nuclear shielding constant is 3.2×10^{-5}.

539

13753. THE EFFECT OF MOLECULAR INTERACTION ON MAGNETIC SHIELDING CONSTANTS. M.J.Stephen.
Molecular Phys., Vol. 1, No. 3, 223-32 (July, 1958).

The effect of molecular interactions on magnetic shielding constants in gases and liquids is considered using simple statisti mechanics and treating the molecules as points. For gases at ordinary pressures the effects are small. For liquids and solutic two effects may be important: (i) magnetic moments induced in neighbouring molecules give rise to a magnetic field at the nucleu of the molecule considered; (ii) the electron distribution in the molecule may be distorted by the electric field due to neighbourin molecules and a change in the intramolecular shielding constant will then take place. The magnitude of these effects is estimated and their relative importance in different molecules is discussed.

539

13754. ANTISHIELDING AND POLARIZABILITIES IN ALKALI HALIDE GASES. G.Burns.
Phys. Rev., Vol. 115, No. 2, 357-65 (July 15, 1959).

The ionic model that has been used in an attempt to explain eQq/h data in ionic gases and solids is examined, extended, and a plied to alkali halide gases. It is shown that the antishielding fact γ_∞, multiplies the unshielded value of q, $(\partial^2 V/\partial Z^2)$, produced not only by an external charge but by all the external moments, and s of these effects are important in alkali halide gases. In order to estimate the magnitude of the contributions to q of such moments polarizabilities are calculated that apply to alkali halide internuc distances. These polarizabilities are often much smaller than th calculated for the free ion. Polarizabilities and γ_∞'s are calcula using both Hartree and Hartree—Fock wave-functions and are co pared. The values obtained using the Hartree—Fock wave-functions are consistently smaller. Some second order calculations the polarizabilities and antishielding factors are calculated by a direct substitution method. The results indicate that for the alka halide gas calculations perturbation theory is applicable to the al ions but not to the easily deformable halide ions for the situation considered here. This is probably the reason the ionic model has always yielded poor results for the halide ions. When the ionic model is extended, as described in this paper, and applied to the alkali ions, a set of antishielding factors is found for which there agreement between theory and experiment or would be if Hartree Fock wave-functions were available to calculate γ_∞. From this model the nuclear quadrupole moment, Q, of Li^7 is found to be -0.016×10^{-24} cm^2.

539

13755. INDIRECT NUCLEAR SPIN—SPIN COUPLINGS IN SATURATED HYDROCARBON MOLECULES. E.Hirotke.
Progr. theor. Phys., Vol. 21, No. 6, 943-4 (June, 1959).

Calculations of $J_{H_1H_2}$ using a more accurate wave-function t before (Abstr. 8060 of 1957) confirm experimental evidence that value is small when the distance between the protons is large and also when the electronegativities of atoms bonded to the protons large and that it is independent of the electronegativities of the o atoms. A numerical calculation of $J_{H_1H_2}$ for methane is found to in good agreement with experiment. R.A.Ballin

539.19

6. THEORY OF THE DIPOLE MOMENTS OF POLYMERIC ECULES. O.B.Ptitsyn, T.M.Birshtein and Yu.A.Sharonov. Akad. Nauk SSSR, Ser. fiz., Vol. 22, No. 3, 324 (1958). ussian. English summary: PB 141041T-3, obtainable from e of Technical Services, U.S. Dept. of Commerce, Washington, , U.S.A.

The theory connects the dipole moment of the polymeric chain its chemical structure. Comparison of the theory with the erties of poly-p-halogen styrenes and polychlorovinyl shows the phenyl series or the Cl atoms repel more intensely than the oms. The retardation of rotation determined from dipole mots obtained from experimental data corresponds to that deter-ed from the size of the molecules and from the photoelastic ient. R.C.Kell

539.19 : 538.2

7. CALCULATION OF MAGNETIC PROPERTIES OF THE ROGEN MOLECULE. H.F.Hameka. Naturforsch., Vol. 14a, No. 7, 599-602 (July, 1959). In German.

The author introduces wave-functions based on the gauge-riant atom functions, for the calculation of the screening of the ons and of the magnetic susceptibility of the H_2 molecule. The al calculations are carried out for two cases, the wave-function he ground state being described either by the Wang or the Rosen roximation. The nuclear screening constant and the suscept-ty amount, for the first case, to 2.631×10^{-5} and -3.920×10^{-6} for the second case, to 2.732×10^{-5} and -4.045×10^{-6}, respec-y. F.Lachman

539.19 : 548.736.3

MOLECULAR STRUCTURE OF B_8Cl_8. See Abstr. 12879-80

539.19 : 535.3

8. EFFECT OF INTERMOLECULAR INTERACTION ON ECULAR SPECTRA. S.I.Kubarev. . Akad. Nauk SSSR, Vol. 126, No. 5, 971-4 (June 11, 1959). ussian.

An attempt at explaining various spectroscopic manifestations ntermolecular interactions (shift, broadening, temperature ndence in systems with H bonds) from a general point of view, he basis of the method developed by Lax (Abstr. 1247 of 1953) onnection with the discussion of the Franck—Condon principle pplied to crystals. F.Lachman

539.19

9. NOTE ON A NEW POTENTIAL FUNCTION. Pollara and P.T.Funke. hem. Phys., Vol. 31, No. 3, 855-6 (Sept., 1959).

The proposed intermolecular potential has a square-well lsion and $1/r^6$ attraction; it fits the virial coefficient of $H_2)_4$ as well as the (28,7) potential and much better than the 6) potential. J.Hawgood

539.19 : 539.2

0. STRUCTURES OF ELECTRON-TRANSFER AND RELATED ECULAR COMPLEXES IN THE SOLID STATE. O.Hassel. ecular Phys., Vol. 1, No. 3, 241-6 (July, 1958).

Discusses some results obtained during recent years from ay investigations of solid addition compounds thought to be ned by electron transfer between molecules containing closed l atoms. It is hoped that the results which apply directly to ds only might contribute to the understanding of the bonds ned also in the complexes which have been proved to be present in liquid mixtures.

539.19

1. DISSOCIATION OF THE MOLECULAR ION H_2^+ IN LISIONS WITH GASES. Fedorenko, V.V.Afrosimov, R.N.Il'in and D.M.Kaminker. eksper. teor. Fiz., Vol. 36, No. 2, 385-92 (1959). In Russian.

Measurements were made of the cross-sections σ_{H^+} for forma-of protons resulting from dissociation of molecular hydrogen H_2^+ in single collisions occurring in helium, argon, hydrogen or The energy (T) of the H_2^+ ions varied between 5 and 180 keV. hydrogen and helium the curves σ_{H^+} (T) possess two maxima, e for argon and air they rise monotonically. The angular dis-ution of primary 24 keV H_2^+ ions scattered in argon without ge of e/m was investigated as well as the distribution of H^+ H^- ions formed as the result of dissociation. It is concluded that with decrease of the distance of closest approach between the nuclei of the colliding particles the relative probability of scattering with dissociation increases.

539.19

13762. MOLECULAR MOTION IN SOME GLASSY POLYMERS. W.P.Slichter and E.R.Mandell. J. appl. Phys., Vol. 30, No. 10, 1473-8 (Oct., 1959).

Molecular motion in several glassy polymers was examined by proton resonance methods in the temperature range 77-425°K, and is interpreted in terms of the detailed behaviour of molecular chains and substituents. Comparisons are made between transitions seen by proton resonance and glass transitions seen by other methods. Powles' observations on poly(methyl methacrylate) are qualitatively borne out. The influence of thermal history and polymerization conditions is considered. Motion has been examined also in several polymeric methacryl·tes, including the ethyl, n-butyl, isobutyl, n-hexyl, n-octyl, lauryl docosyl, and cyclohexyl esters. Some details of molecular configuration are considered for the ethyl ester. In poly(methyl alpha-chloroacrylate) the low-temperature values of the second moment are much smaller than expected. These depressed values are ascribed to rotation of all of the methyl groups about the three-fold axis.

539.19

13763. NOTE ON THE MELT CONFIGURATION OF POLYETHYLENE. D.W.McCall and D.C.Douglass. J. chem. Phys., Vol. 31, No. 3, 860-1 (Sept., 1959).

Measurements of the viscosity and of the coefficients of self-diffusion are combined to give mean square end-to-end distances and radii of gyration. The results for polymers fit with the hindered rotator model, but the theoretical treatment breaks down for very short chains. R.F.Barrow

539.19 : 548.5

SPHERULITIC CRYSTALLIZATION IN POLYPROPYLENE. See Abstr. 13890

539.19 : 548.737

SECOND CRYSTAL FORM OF POLYPROPYLENE. See Abstr. 13957

539.19 : 539.42

MECHANICAL BREAKDOWN AND MOLECULAR ORIENTATION OF A MODEL LINEAR HIGH-POLYMER SOLID. See Abstr. 13864

539.19

13764. AMORPHOUS AND UNORIENTED CHARACTER OF POLYMERS FORMED IN RADIATION INDUCED SOLID STATE POLYMERIZATION. G.Adler. J. chem. Phys., Vol. 31, No. 3, 848-9 (Sept., 1959).

539.19 : 536.48

13765. ARGON DEPOSITION ON A 4.2°K SURFACE. S.N.Foner, F.A.Mauer and L.H.Bolz. J. chem. Phys., Vol. 31, No. 2, 546-7 (Aug., 1959).

The rate of deposition of argon from a beam of gas molecules was followed by measuring X-ray attenuation in the solid argon, and found to be independent of the sample thickness. Condensation coefficients around 0.7 were obtained. A.R.Stokes

SOLID-STATE PHYSICS

539.2 : 536.7

13766. THE THERMODYNAMIC BEHAVIOUR OF SOLIDS. M.A.Jaswon. Research, Vol. 12, No. 7, 274-84 (July, 1959).

A review of various developments of interest, some of them quite recent. P.T.Landsberg

539.2

13767. THE LATTICE ENERGIES OF ALKALINE EARTH FLUORIDES. H.J.Harries and D.F.C.Morris. Acta cryst., Vol. 12, Pt 9, 657-9 (Sept., 1959).

The lattice energies U_0 of the alkaline earth fluorides CaF_2, SrF_2, and BaF_2 were derived by term-by-term theoretical calculation. The results are compared with "experimental lattice energies" U obtained from thermodynamic data using the Born—Haber cycle. The

values of U_0 and U are respectively for CaF_2, 610, 617; for SrF_2, 582, 584; and for BaF_2, 550, 549 kcal/mole at 0°K. The small discrepancies in the case of CaF_2 and SrF_2 are attributed to some deformation and interpenetration of the ions in the crystals.

539.2

13768. CONVEX-CORE MODEL OF MOLECULES IN CRYSTALLINE STATE. T.Kihara and S.Koba.
J. Phys. Soc. Japan, Vol. 14, No. 3, 247-52 (March, 1959).

The convex-core model of nonspherical molecules, introduced by Kihara (Abstr. 4261 of 1954) is applied to crystals of methane, carbon dioxide, and nitrogen. By use of model parameters determined from the second virial coefficients, lattice constants and cohesive energies are calculated. For methane, results of the calculations agree with observed values when the zero-point energy and the effect of potential non-additivity are taken into account. The crystal structure, the lattice constant and the cohesive energy of carbon dioxide are explained by use of a convex-core model with an embedded electric quadrupole.

539.2

13769. LATTICE ENERGIES AND OTHER PROPERTIES OF CRYSTALS OF ALKALINE EARTH CHALCOGENIDES. M.L.Huggins and Y.Samamoto.
J. Phys. Soc. Japan, Vol. 12, No. 3, 241-51 (March, 1957).

The lattice energies of the 20 binary compounds composed of Be^{++}, Mg^{++}, Ca^{++}, Sr^{++}, Ba^{++}, O^{--}, S^{--}, Se^{--} and Te^{--} were computed by previously well-tested procedures. Because of lack of sufficiently reliable compressibility data, the computations were made with two different assumptions regarding the magnitude of the constant a in the exponent of the repulsion energy term. These two assumptions yield lattice energies which differ, in most cases, by about 20 kcal. In general, a single value of the "constant energy radius" suffices for each type of ion. For the beryllium compounds, however, it was necessary to use different radii for the Be^{++} ion for each compound. In MgTe also, a slightly different Mg^{++} radius from that deduced for the other magnesium compounds was required. These irregularities may be related to the fact that these crystals have "tetrahedral" structures, unlike the others, with significant but unknown amounts of covalent bonding. The characteristic constants deduced should be useful in the theoretical treatment of many properties dependent on interactions between ions, both in these crystals and in other systems. For these crystals, the interionic distances, compressibilities and maximum infrared lattice-vibration frequencies have been computed. By combining the computed lattice energies with thermochemical data, electron affinities (for the addition of two electrons to each of the electronegative atoms) have been computed and compared. Based on these results, the authors' best estimates, in kcal/mole, are as follows: O, −162 ± 15; S, −99 ± 15; Se, −117 ± 15; Te, −97 ± 20.

539.2

13770. THE ELECTRON DISTRIBUTION AND THE LOCATION OF THE BONDED HYDROGEN ATOM IN CRYSTALS. Y.Tomiie.
J. Phys. Soc. Japan, Vol. 13, No. 9, 1030-7 (Sept., 1958).

Investigated using mainly the VB method with the Gaussian approximation to the Slater wave-functions. This approximation appears to be fairly good if the thermal vibration is considerable. The C—H bond is studied as an example. It is concluded that the position of the maximum electron density around the proton is located more or less towards the heavier atom, and hence an apparent bond contraction in the X-ray analysis should occur. This seems to be in accord with experimental results. The apparent bond shortening increases and the peak density decreases with increase in the ionic character of the bond. For a constant value of the ionic character, the magnitude of the apparent bond shortening rapidly reaches a certain constant value when thermal vibration becomes large.

539.2

13771. ON THE STRENGTHS OF BONDS IN CRYSTALS OF THE ELEMENTS OF GROUPS V AND VI OF THE MENDELEEV PERIODIC SYSTEM OF THE ELEMENTS. A.V.Stepanov.
Dokl. Akad. Nauk SSSR, Vol. 124, No. 4, 800-2 (1959). In Russian.

An attempt is made to calculate the degree of molecular association in these crystals. Bond strength data for simple gaseous molecules are used to calculate lattice energies, etc., for hypothetical f.c.c. crystals (in which the bond forces are identical to those in the simple molecules). Comparisons of these calculated values with those found experimentally for real crystals enable estimates of intramolecular and intermolecular bond energies to b made. The latter appear to be relatively small (~ 1 kcal/mole or less), even for Bi and Sb, and are given, approximately, by the product of the gas constant, R, and the melting temperature. It is suggested that the molecular structure must be taken into acc in considering the physical properties of crystals of these elemen C.H.L.Goodm

539

13772. COHERENT ATOMIC SCATTERING FACTORS FOR THE LITHIUM HYDRIDE CRYSTAL FIELD. R.P.Hurst.
Phys. Rev., Vol. 114, No. 3, 746-51 (May 1, 1959).

Describes an effort made to evaluate the coherent atomic scattering factors for the lithium and hydride ions as they exist in the LiH crystal field. The two electron wave-functions chosen to describe these ions are each in turn optimized in the field of posi and negative point charges arranged as the corresponding ions are arranged in the crystal. Using the orbital exponents obtained fro the minimization process, atomic scattering factor calculations a made in the usual way. The factors for Li^+ are unchanged. Inter ing effects are noted for the H^- scattering factors. The energy of the ions in the field of point charges is related to the crystal cohesive energy. Specifically, neglecting the zero-point energy correction, the calculated open configuration results were −236.3 and −227.4 kcal/mole when compared with computed and experimentally determined free H^- reference energies, respectively. T experimental cohesive energy is −218.5 kcal/mole. Finally, it wa noted that the H^- ion contracts in the crystal field. A possible explanation for this effect is given.

53

13773. A QUALITATIVE INVESTIGATION OF THE WAVE FUNCTIONS OF METALLIC URANIUM. E.C.Ridley.
Proc. Roy. Soc. A, Vol. 247, 199-213 (Sept. 16, 1958).

The potential field and wave-functions in metallic uranium have been calculated approximately by determining Hartree self-consistent fields for the four configurations $(6d)^6$, $(5f)^2\ (6d)^2\ (7s)^2$, $(5f)^4\ (6d)^2$, and $(5f)^6$ using the Wigner—Seitz boundary condition at the surface of the equivalent atomic sphere. In the self-consisten field obtained for each configuration, wave-functions falling to ze at the surface of the sphere were evaluated for the outer electron The differences between the Hartree ϵ-parameters for the two boundary conditions were used to give an indication of the relativ band widths. The (5f) wave-function has its principal maximum inside the (6s) (6p) shell, but is appreciable at the surface of the sphere and must participate in bonding. The binding energy of an electron in the (5f) wave-function is 0.3934 rydbergs in the config uration $(5f)^2\ (6d)^2\ (7s)^2$ as given by the Hartree ϵ-parameter. The (6d) function has its maximum charge density at the boundary and with a binding energy of 0.1749 rydbergs in the same configuratio is likely to form a good metallic band. The (7s) function has a large negative binding energy and is not likely to occur. In the configuration $(5f)^2\ (6d)^2\ (7s)^2$ the bandwidths of the (5f), (6d) and (7 functions are in the ratio 1 : 9.8 : 22.7. As the number of (5f) ele trons is increased all the binding energies decrease and the band widths increase. At the same time the (6s) and (6p) functions are markedly perturbed, the functions (5s), (5p) and (5d) to a lesser extent.

53

13774. THE CALCULATION OF THE FREE ENERGY OF CRYSTALS WITH DEFECTS. K.Fischer.
Z. Phys., Vol. 155, No. 1, 59-68 (1959).

The potential energy of the crystal is developed in a usual wa and the free energy is obtained in the harmonic, and also in the n higher, approximation. Other thermal properties are mentioned briefly. P.T.Landsb

53

13775. A NEW FORM OF THE POLAR MODEL OF CRYSTALS. A.E.Glauberman, V.V.Vladimirov and I.V.Stasyuk.
Dokl. Akad. Nauk SSSR, Vol. 126, No. 3, 543-5 (May 21, 1959). In Russian.

Three difficulties in the Schubin—Wonsowsky polar model (Abstr. 2991 of 1934) are outlined and overcome in the theory presented. Application of the theory to a semiconductor under crossed fields is given, and further application to mixtures of semiconductors and for the inclusion of excitons is proposed. D.J.Hun

539.2

776. THE EXISTENCE OF TETRAHEDRAL PHASES.
.Folberth.
Naturforsch., Vol. 149, No. 1, 94-6 (Jan., 1959). In German.
Application of the Grimm–Sommerfeld rule (tetrahedral ucture is favoured when the number of electrons per atom on average is four) in repeated "cross substitution" (giving, in nary compounds for example, $A^{I}B^{III}C_2^{VI}$ and $A^{II}B^{IV}C_2^{V}$) reveals rge (over 100) number of possible tetrahedral phases. Three teria are discussed, the fulfilment of which limits the number e expected to considerably less. W.Good

539.2

777. APPLICATION OF NONLINEAR ELASTICITY THEORY TO FECT SITES IN CRYSTALS. A.Seeger and E.Mann.
Naturforsch., Vol. 14a, No. 2, 154-64 (Feb., 1959). In German.
The nonlinear elasticity theory provides an improved descrip-, compared with the linear theory, of the immediate neighbour- d of lattice defects at which large strains may occur. The theory pplied to dilation, to a screw dislocation in an isotropic medium to an interstitial atom. J.Franks

539.2 : 548.5

778. EFFECT OF SUBSTRATE CRYSTALLINE PERFECTION EPITAXIAL GROWTH. A.K.Chatterji.
ppl. Phys., Vol. 30, No. 9, 1448-9 (Sept., 1959).
It is concluded, from electron diffraction photographs of Fe_3O_4 stals grown on a silver substrate, that when imperfections are wn in, one obtains imperfect alignment, but when imperfections put in by bending, the alignment is nearly perfect.
A.R.Stokes

539.2

779. THE DEFORMATION OF A WHISKER WITH SCREW SLOCATION. F.Kroupa.
ech. J. Phys., Vol. 8, No. 6, 740-1 (1958).
Eshelby calculated, using classical elasticity theory, the isting of a whisker caused by the presence of a screw dislocation ng its axis. It is pointed out that the calculated total rotation is large that the assumptions of the theory are not completely lfilled. For this reason the deformation can be more complicated: r example, the axis of the whisker can be deformed from a straight e into a corkscrew. Such a deformation was observed in a rubber e used as a model for a whisker. B.T.M.Willis

539.2

780. DISLOCATION SOURCES IN CRYSTALS. J.J.Gilman.
ppl. Phys., Vol. 30, No. 10, 1584-94 (Oct., 1959).
Lithium fluoride crystals were subjected to short stress pulses -10 μsec in length) in order to study dislocation nucleation in them. was found that several heterogeneities can lead to dislocation cleation: (a) cleavage steps, (b) dislocation loops, (c) glide bands,) inclusions or "dirt" particles, (e) precipitates (as-grown), and radiation-induced precipitates. Also, it was found that annealing eatments at moderate temperatures (200-600°C) followed by apid" cooling (> 5°C/hr) made segments of previously pinned dis- cations become mobile. These mobile segments multiplied as they ved through the crystals. Several treatments were tried that were effective in producing dislocation nucleation. These included: tem- rature changes, surface wetting, simultaneous irradiation and ressing, reflections from free surfaces, and diagonal bending. refully cleaned glass spheres were pressed into contact with dis- cation-free regions of a LiF crystal. In this way, shear stresses at were 100 times greater than the normal yield stress of the crys- l (~ G/85) were reached without causing homogeneous dislocation cleation. It is concluded that small foreign heterogeneities cause ost of the dislocation nucleation in real crystals. Homogeneous cleation occurs only at high stresses (~ G/30). Relatively little slocation multiplication results from classical Frank–Read sour- s (almost none in LiF). Most dislocation multiplication occurs as prior dislocation moves through a crystal.

539.2

781. DETECTION OF DISLOCATIONS BY MEANS OF LTRASONICS. A.P.Kapustin.
ristallografiya, Vol. 4, No. 2, 265-7 (March-April, 1959). In Russian
LiF crystals were exposed in water to an ultrasonic field of equency 25 kc/s and of intensity 0.5 W/cm². The etch figures oduced corresponded with those obtained by standard etching methods and similar results were obtained with other crystals. It is concluded that the ultrasonic etch figures indicate the presence of dislocations. R.F.S.Hearmon

539.2

13782. DISLOCATION DYNAMICS AT LOW TEMPERATURES.
J.Lothe and J.P.Hirth.
Phys. Rev., Vol. 115, No. 3, 543-50 (Aug. 1, 1959).
A model for low-temperature dislocation motion is developed using the concept of nucleation and growth of kinks in dislocations lying in Peierls potential troughs. The model is compared with existing experimental data.

539.2

13783. INTERMOLECULAR FORCES AND CRYSTAL PROPERTIES OF METHANE. E.Whalley.
Phys. of Fluids, Vol. 2, No. 3, 335-6 (May-June, 1959).
The lattice vibrations in CH_4, CH_3D and CD_4 are assumed to be made up of two groups, one translational, with characteristic temperature θ_T, the other rotational, with characteristic temperature θ_R. Formulae are given for θ_T and θ_R of CH_3D and CD_4 in terms of θ_T and θ_R of CH_4. Using values $\theta_T(CH_4) = 82°K$ and $\theta_R(CH_4) = 158°K$, good agreement is obtained between observed and calculated specific heats of all three substances, and the above values of θ_T and θ_R give a zero point energy of 536 ± ~ 100 cal/mole for CH_4. The heat of vaporization is calculated to be 1897 ± 5 cal/mole, leading to a lattice energy of 2433 ± ~ 100 cal/mole. This value differs so little from that used by Schamp et al. (Abstr. 112 of 1959) that their conclusions regarding intermolecular forces need no important alteration. R.F.S.Hearmon

539.2 : 548.74

THERMAL VIBRATION AMPLITUDES IN EVAPORATED FILMS OF F.C.C. CRYSTALLITES. See Abstr. 13961

539.2 : 539.18

INTERACTION OF A CRYSTAL WITH AN INCIDENT ATOMIC BEAM. See Abstr. 13736

539.2 : 534.23

ABSORPTION OF COMPRESSIONAL WAVES IN SOLIDS FROM 100 TO 1000 Mc/sec. See Abstr. 13107

539.2

13784. ON THE 3d ELECTRON BAND IN BODY CENTERED STRUCTURE. M.Suffczyński.
Acta phys. Polon., Vol. 16, No. 1-2, 157-60 (1957).
In an LCAO approach after that of Abstr. 8468 (1954), the secular equations can be solved analytically for certain directions of high symmetry even when next-nearest neighbours are included. The results of doing this, using the two-centre approximation for the integrals, are presented. J.Hawgood

539.2

13785. d BANDS IN THE BODY-CENTERED CUBIC LATTICE.
J.Callaway.
Phys. Rev., Vol. 115, No. 2, 346-8 (July 15, 1959).
A model of a crystal, consisting of positive point charges neutralized by a uniform distribution of negative charge, is employed to study the form of the d-bands in a body-centred cubic lattice as a function of the lattice spacing. The wave functions are expressed as linear combinations of plane waves and the potential treated as a perturbation. It is shown that the perturbation series for the energy is a power series in Za, where Z is the atomic number and a is the lattice parameter. The leading term in the series is of the order $(1/a)^2$, and the coefficients of successive terms in the series decrease rapidly. The first three terms are evaluated for the states of predominantly d symmetry at the centre of the Brillouin zone, and the corner H.

539.2

13786. INTERACTION OF EXCITON WITH R CENTER IN KCl CRYSTALS. M.Ueta and M.Hirai.
J. Phys. Soc. Japan, Vol. 14, No. 4, 546 (April, 1959).
A KCl crystal was irradiated with light of wavelength 5461 A until equilibrium was attained between F centres and other complex centres. On irradiation with u.v. between 185 and 205 mμ, the R-bands disappeared and the F-band absorption increased. K and N band absorption decreased slowly. The R-centres were destroyed by thermal spikes produced by excitons, when the crystal was irradiated in the exciton absorption band. J.Franks

6

539.2

13787. KINETICS OF VACANCY MOTION IN HIGH-PURITY ALUMINUM. W.DeSorbo and D.Turnbull.
Phys. Rev., Vol. 115, No. 3, 560-3 (Aug. 1, 1959).

It is shown that in very high-purity aluminium, Al_{II}, the rate of vacancy annealing depends on vacancy concentration and annealing temperature but is independent of the temperature T_i of vacancy injection per se. The rate can be described as the sum of first and second order components. The first order component becomes most prominent at a monovacancy concentration estimated to be 10^{-6} atom fraction. It is shown that the results are consistent with the Koehler–Seitz–Bauerle dissociative mechanism. The activation energy for diffusion of monovacancies in Al_{II} is found to be 0.65 ± 0.06 eV. This, combined with earlier results on the formation energy of vacancies, gives 1.44 ± 0.11 eV for the activation energy for self-diffusion in aluminium by a monovacancy mechanism. In zone-refined aluminium, Al_I, of lesser purity, the rate of vacancy annealing depends upon T_i per se and falls off more rapidly with decreasing vacancy concentration than in Al_{II}. Two hypotheses for the impurity effects are considered, namely: (1) trapping of vacancies by impurity atoms and (2) inhibition of dislocation climb by adsorbed impurities.

539.2 : 530.162

13788. TRANSPORT PHENOMENA IN ELASTIC ANISOTROPIC METALS. J.Appel.
Z. Naturforsch., Vol. 14a, No. 4, 379-93 (April, 1959). In German.

The transport properties of anisotropic metals are investigated taking into account the dependence on direction and the dispersion of the phase and group velocities of the lattice vibrations. The perturbation calculation of the interaction between electrons and phonons follows Bardeen's (1937) procedure, the symmetry of the perturbing potential being fully considered. The resulting integral equation is formulated as a variation principle. The perturbation of the electron distribution function by external fields is developed in a series of spherical harmonics, also with the appropriate symmetry, and the methods of group theory allow a straightforward calculation of thermal and electric conductivity and of thermoelectric power. L.Pincherle

539.2

13789. ELECTRONS IN POLAR CRYSTALS. G.L.Sewell.
Phil. Mag. (Eighth Ser.), Vol. 3, 1361-80 (Dec., 1958).

The theory of the properties of an electron in a polar crystal is investigated by means of a model which takes account of the atomicity of the lattice. The method used is essentially that of a tight-binding approximation in which the interaction of the electron with the lattice displacements is built into the theory from the start. This method is valid only in cases where the tight-binding approach is appropriate even when the effects due to the lattice displacements are ignored. Thus, the eigenstates of the system are constructed as linear combinations of localized states. In each of the localized states, the electron is bound to one positive ion, and displaces the neighbouring ions. The transfer of the electron between ions is therefore accompanied by a transfer of the mean position of the neighbouring ions. The effective mass of the electron is consequently increased as a result of the displacements it carries with itself. It is found that this effective mass increases exponentially with the electron–phonon coupling and can thus be extremely large in the strong coupling case. It is also found that the effective mass increases with temperature, since the random thermal motion of the ions opposes the motion of the lattice displacements accompanying the electron.

539.2 : 539.19

STRUCTURES OF ELECTRON-TRANSFER AND RELATED MOLECULAR COMPLEXES IN THE SOLID STATE. See Abstr. 13760

539.2

13790. THEORY OF NEGATIVE-MASS CYCLOTRON RESONANCE. D.C.Mattis and M.J.Stevenson.
Phys. Rev. Letters, Vol. 3, No. 1, 18-20 (July 1, 1959).

A study of the conditions necessary to observe power emission rather than absorption from negative-mass carriers, as reported by Dousmanis et al.(Abstr. 2319 of 1959). It is concluded that in general emission can occur only if a non-equilibrium "inverted" distribution of carriers is first set up, so that the distribution function f(E) increases with energy E in the relevant range of energies. R.G.Chambers

539

13791. ROLE OF NEGATIVE EFFECTIVE MASS IN NEGATIVE RESISTANCE. P.Kaus.
Phys. Rev. Letters, Vol. 3, No. 1, 20-3 (July 1, 1959).

Deals with the same problem as Mattis and Stevenson (preceding abstract) from a rather different viewpoint, and reaches essentially the same conclusions. R.G.Chambe

539

13792. CYCLOTRON RESONANCE IN ALUMINUM. D.N.Langenberg and T.W.Moore.
Phys. Rev. Letters, Vol. 3, No. 3, 137-8 (Aug. 1, 1959).

Azbel–Kaner type oscillations have been observed in the surface resistance at 24 kMc/s, at 4.2°K and at fields up to 15 kG Two groups of oscillations were found, corresponding to effective masses of 1.5 m_0 and about 0.18 m_0. R.G.Chambe

539

13793. CYCLOTRON RESONANCE IN ALUMINUM. E.Fawcett.
Phys. Rev. Letters, Vol. 3, No. 3, 139-41 (Aug. 1, 1959).

Azbel–Kaner oscillations were observed in the surface resistance at 36 kMc/s, at 4.2°K and at fields up to 6 kG. Two groups of oscillations were found, corresponding to effective mass of about 0.12 m_0 and 0.3 m_0. R.G.Chambe

539

13794. PARAMAGNETIC RESONANCE OF F-CENTRES IN STA MAGNETIC FIELDS OF ARBITRARY STRENGTH.
M.F.Deigen and A.B.Roitsin.
Zh. eksper. teor. Fiz., Vol. 36, No. 1, 176-85 (1959). In Russian.

The hyperfine interaction of a F-centre electron with the magnetic moments of nuclei of the first coordinational sphere surroun ing the vacancy is examined for the case when a static field of arbitrary strength is present. The hyperfine splitting has been evaluated for F-centres in a KCl crystal. Transitions between hyperfine levels induced by a radiofrequency field are considered. In the absence of an external static field these transitions are fou to be allowed. Paramagnetic resonance of F-centres of which onl one of the nuclei of the first coordinational sphere has a magnetic moment is considered specially. In this case the frequencies and intensities of paramagnetic resonance absorption depend on the orientation of the crystal in the static magnetic field. The absorp intensity also depends on the orientation of the crystal with respe to the vector of the magnetic field of the wave incident on the crys

539.2 : 535.

13795. ON THE SCATTERING OF LIGHT BY NaCl CRYSTALS. E.Kappler and G.Pampus.
Ann. Phys. (Leipzig), Folge 7, Vol. 4, No. 1-5, 178-87 (1959). In German.

Scattering centres were observed in a pure crystal with an ultra-microscope. The centres were more numerous after plasti deformation and were clustered in (110) glide planes. At high magnifications a complicated structure was observed in these planes, consisting of an irregular network with a fibrous fine stru ture. It is possible that this fine structure corresponds to elemen tary dislocations. B.T.M.Will

53

13796. DICHROISM OF COLOR CENTERS IN KCl CRYSTAL. T.Ishii, T.Tomiki and M.Ueta.
J.Phys. Soc. Japan, Vol. 13, No. 11, 1411-12 (Nov., 1958).

The dichroism of the M-band in additively coloured crystals is shown to be markedly affected by temperature. The dichroism not only associated with reorientation of symmetry axes of excite M-centres but also with ionic motion. G.F.J.Garl

539.

13797. THE EFFECT OF γ-RADIATION ON SOLID MATERIALS PARTICULARLY METALS. F.Bollenrath and K.H.Lindackers.
Atomkernenergie, Vol. 4, No. 5, 201-3 (May, 1959). In German.

The state of a material in a nuclear reactor is affected simultaneously by several different kinds of radiation; to study th effect of γ-rays alone the material must be irradiated with a stro γ-source. The number of Frenkel defects to be expected from γ-irradiation is estimated. B.T.M.Wil

539.

13798. THE EFFECT OF IRRADIATION ON STRESSES AND SMALL DEFORMATIONS IN SOLIDS. Yu.I.Remner.
Dokl. Akad. Nauk SSSR, Vol. 124, No. 3, 540-1 (1959). In Russian

Relationships are given between stresses and small deformas in crystalline solids which expand under irradiation. Isotropic tic and elastic—plastic cases are considered. J.Adam

539.21

9. ELECTRON-BOMBARDMENT DAMAGE IN OXYGEN-FREE CON. G.K.Wertheim and D.N.E.Buchanan.
ppl. Phys., Vol. 30, No. 8, 1232-34 (Aug., 1959).
This was compared with that found in pulled crystals which have n previously reported (Abstr. 11242, 11243 of 1959). It was found, greement with conclusions drawn from spin resonance experiits, that the level 0.16 eV below the conduction band is associated oxygen. In oxygen-free silicon a deep level 0.38 eV below the duction band is produced in dominant density, and a broad shallow el in lesser concentration. The 0.16 eV level is not produced. difference between this level scheme and that found in pulled stals which contain oxygen emphasizes the hitherto unsuspected ortance of impurities in the formation of the stable defects, ing the rearrangement of the vacancies and interstititals produced he primary displacement.

539.21

00. NEUTRON IRRADIATION EFFECTS IN A COPPER—UMINIUM ALLOY. C.R.Houska and B.L.Averbach.
ppl. Phys., Vol. 30, No. 10, 1525-31 (Oct., 1959).
Diffuse X-ray scattering and peak intensities were measured a polycrystalline alloy of copper —14.5 atomic percent aluminium ore and after irradiation. It was shown that the average shortge order configuration in the first five neighboring shells was newhat enhanced as a result of the irradiation. In addition, a perature independent rise was observed in the diffuse scattering. s was interpreted in terms of static atomic displacements arising n the localized volume changes associated with neutron damage. absence of line broadening or significant line shifts after adiation is further confirmation of the localized nature of the nage. Defect models of radiation damage involving short range cts which average out over larger distances in the lattice are cussed.

539.21

01. A DOSE TEST FOR IRRADIATED POLYETHYLENE.
I.Cornish and D.M.Cutting.
ure (London), Vol. 183, 1804-5 (June 27, 1959).
Two dose tests are described. The first is based on the erimental evidence that, using a Williams plastimeter, under a ding of 5 kg on a standard test piece at 150°C, the deformation in in varies with dose received up to 80 Mrad. In the second test irradiated polyethylene is extruded at 150°C using a Hounsfield someter with extrusion attachment. The extrusion pressure ckly stabilizes to a steady value which depends upon the dose eived. Graphs are reproduced of dose against deformation and rusion force respectively. Expanded polyethylene may be tested ng the second method. B.J.Wilson

539.21

02. TRACER STUDIES ON RADIATION DAMAGED GRAPHITE.
Montet, G.Hennig and A.Kurs.
lear Sci. Engng, Vol. 1, No. 1, 33-52 (March, 1956).
The distribution of displaced carbon atoms was studied. liation-damaged graphite containing radioactive displaced bon (C^{11}) atoms was prepared by cyclotron or betatron irradia-. After partial annealing, the distribution of the C^{11} was deter-ed by controlled oxidation and counting of CO_2 gas samples. periments on various types of weakly irradiated graphite indicate a very small fraction of the displaced atoms are driven to ticle surfaces during the annealing process, the fraction being ner for natural graphite than for artificial graphite and varying ersely with graphite particle size. Experimental conditions e varied to determine their effects on the distribution of the placed atoms. Data obtained indicate that very little reintegra- of displaced atoms occurs during short neutron bombardments room temperature, that about 80% of the atoms reintegrate into ancies during annealing below 400°C and that the remainder lesce into complexes, and that large scale motion of the comxes begins at 400°C and ceases at approximately 1000°C. At latter temperature the complexes appear to reach their final itions; however, they are relatively loosely bound and integrate gressively at these sites until they become indistinguishable m lattice atoms near 1700°C. Vacancies resulting from prior adiation were found by tracer experiments to be effective traps displaced atoms so that, during annealing of subsequent damage, the fraction that reaches the particle surfaces decreases rapidly with bombardment.

539.21 : 537.311.33

13803. TEMPERATURE-DEPENDENT DEFECT PRODUCTION IN BOMBARDMENT OF SEMICONDUCTORS. G.K.Wertheim.
Phys. Rev., Vol. 115, No. 3, 568-9 (Aug. 1, 1959).
For previous work, see Abstr. 4991 (1958). A model is proposed to explain the observed dependence of the defect production rate on temperature when semiconductors are bombarded with electrons of sufficient energy to produce vacancy-interstitial pairs. The decreased defect density observed after low-temperature bombardment may be due to the production of a metastable vacancy-interstitial pair which may either anneal or form the defect usually observed. A temperature dependence in the production rate arises if these two competing processes have different activation energies.

539.21

13804. SIMPLE SEMIEMPIRICAL MODEL FOR NEUTRON INDUCED STORED ENERGY IN GRAPHITE. J.J.Newgard.
J. appl. Phys., Vol. 30, No. 9, 1449-51 (Sept., 1959).
The energy stored in graphite, after neutron irradiation, does not vary linearly with the cumulative neutron dose. At higher exposures ($> 10^{21}$ nvt) there is apparently a saturation effect. These models are suggested: $E_\alpha = \epsilon_\alpha \tanh \lambda_\alpha D$; $E_\beta = \epsilon_\beta[1-\exp(-\lambda_\beta D)]$; $E = q \log (1 + pD)$. Over the range of D where empirical data exists, all three curves fit well. Until data for higher dosages are available, it is not possible to decide between the models or whether there is a true saturation effect. D.H.Lord

539.21

13805. STORED ENERGY OF IRRADIATED COPPER.
T.H.Blewitt, R.R.Coltman and C.E.Klabunde.
Phys. Rev. Letters, Vol. 3, No. 3, 132-4 (Aug 1, 1959).
To test the hypothesis that the large annealing peak for reactor-irradiated Cu at 30°-50°K arises from the migration of interstitial atoms to vacancies, the stored energy per interstitial-vacancy pair was estimated from refined specific heat measurements. This led to an estimate of 3-5 vacancy-interstitial pairs formed per primary displacement, which is so far from the figure of 120 pairs suggested by theoretical and other considerations as to make it unlikely that irradiation damage in Cu is explicable in terms of simple vacancy-interstitial formation and migration. J.Thewlis

STRUCTURE OF SOLIDS

539.213 : 537.311.32

THE INFLUENCE OF CALCIUM OXIDE ON THE ELECTRICAL CONDUCTIVITY OF GLASSES CONTAINING TWO ALKALI OXIDES.
See Abstr. 13274

539.213.1

13806. CONCERNING THE STRUCTURE AND MECHANICAL PROPERTIES OF AMORPHOUS POLYMERS. M.V. Vol'kenshtein.
Dokl. Akad. Nauk SSSR, Vol. 125, No. 3, 523-5 (March 21, 1959). In Russian.
The behaviour of amorphous polymers is compared with that of ferromagnetic materials, and the analogy shown to be more satisfactory than earlier treatments. It is also suggested that a precipitation process may occur in these materials and not one of vitrification as has previously been considered. On the basis of the analogy with ferromagnetism, the tensile force in a deformed polymer is found as a function of the deformation. The predicted variation is found to be in good agreement with experiment. K.N.R.Taylor

539.217

13807. A STUDY OF DIFFUSION OF Zn AND Se IN Bi_2Se_3, BiSe AND CdSb. A.A.Kuliev and G.B.Abdullaev.
Fiz. tverdogo Tela, Vol. 1, No. 4, 603-5 (April, 1959). In Russian
Diffusion of Zn in Bi_2Se_3 and BiSe between 300° and 400°C and of Se in Bi_2Se_3, BiSe and CdSb between 100° and 200°C was studied by means of radioactive tracers Zn^{65} and Se^{75}. The following relationships were obtained: for Zn in Bi_2Se_3, $D = 5 \times 10^{-9} e^{-17.6/RT}$, for Zn in BiSe, $D = 9.3 \times 10^{-6} e^{-33.5/RT}$, for Se in Bi_2Se_3, $D = 8.5 \times 10^{-9} e^{-30.1/RT}$, for Se in BiSe, $D = 2.5 \times 10^{-9} e^{-15.5/RT}$, for Se in CdSb, $D = 4.67 \times 10^{-9} e^{-12.7/RT}$, where D is the diffusion constant. A.Tybulewicz

539.217

13808. THE X-RAY INVESTIGATION OF HETERO-DIFFUSION IN Cu–Ni ALLOYS. B.Ya.Pines and I.V.Smushkov.
Fiz. tverdogo Tela, Vol. 1, No. 6, 939-45 (June, 1959). In Russian.

From measurements of the concentration and the temperature dependence of the diffusion coefficient D the authors determined the concentration dependence of the activation energy Q and the pre-exponential factor D_0. The X-ray intensities used in the calculation were measured by a microphotometer. The authors also calculated the partial diffusion coefficients and the energy of mixing the two kinds of atom. M.G.Priestley

539.217 : 541.124

13809. AN X-RAY INVESTIGATION OF THE KINETICS OF REACTION DIFFUSION IN THE SYSTEM Al–Sb. B.Ya.Pines and É.F.Chaikovskii.
Fiz. tverdogo Tela, Vol. 1, No. 6, 946-51 (June, 1959). In Russian.

Disks of thin Al foil were fixed to an Sb base and annealed at 570 or 620°C until all the Al had reacted. Using an X-ray method, the authors measured the thickness of both the Al and the AlSb layers at intervals during the anneal. The data obtained were used to calculate the partial heterodiffusion coefficients of the components in AlSb and activation energies for the two processes.
M.G.Priestley

539.217

13810. THE MEASUREMENT OF DIFFUSION COEFFICIENTS BY METHODS OF ACTIVATION ANALYSIS AND ISOTOPIC DILUTION. G.Ya.Ryŭskin.
Fiz. tverdogo Tela, Vol. 1, No. 6, 952-4 (June, 1959). In Russian.

The author considers the possibility of measuring very small diffusion coefficients by activation analysis and isotopic dilution of the total number of atoms which have diffused into a certain region. The number of diffused atoms can be measured by a mass spectrometer or by activation analysis if a neutron source is available. It is estimated that the sensitivity obtainable by these methods is a factor of 1000 better than that of conventional absorption methods, enabling diffusion coefficients of the order of 10^{-17} cm^{2}sec^{-1} to be measured. M.G.Priestley

539.217

13811. EFFECT OF OXYGEN IN SILICON ON PHOSPHORUS DIFFUSION. J.L.Hartke.
J. appl. Phys., Vol. 30, No. 9, 1469-70 (Sept., 1959).

The diffusion coefficient of phosphorus in silicon was measured for silicon samples with concentrations of oxygen differing by several orders of magnitude. No variation with oxygen content was found, indicating that there was no combination of oxygen with the diffusing phosphorus. B.T.M.Willis

539.217

13812. DIFFUSION OF MANGANESE IN SINGLE CRYSTALS OF COPPER. A.Ikushima.
J. Phys. Soc. Japan, Vol. 14, No. 1, 111-12 (Jan., 1959).

The use of Mn^{54} as tracer at 754-950°C enabled the diffusion coefficient to be expressed as $D = D_0 \exp(-Q/RT)$ cm^2/sec, where $\log_{10}D_0 = 7.00 \pm 0.32$ and $Q = 91\,400 \pm 1600$ cal/mole.
R.F.Peart

539.217

13813. DIFFUSION OF IRON IN SINGLE CRYSTALS OF COPPER. Y.Tomono and A.Ikushima.
J. Phys. Soc. Japan, Vol. 13, No. 7, 762-3 (July, 1958).

The diffusion coefficient was measured at several temperatures, using radioactive Fe^{55} and a tracer technique. If the form $D = D_0 \exp(-Q/RT)$ cm^2/sec is taken, the results are: $\log_{10} D_0 = 6.21 \pm 0.87$ (D_0 in cm^2/sec); $Q = 93\,020 \pm 4820$ cal/mole.
M.G.Priestley

539.217

13814. ELECTRON DIFFRACTION DETERMINATION OF THE COEFFICIENT OF HETERODIFFUSION IN THE ALLOYS Cu–Ni, Fe–Ni, Cu–Al and Ag–Al. B.Ya.Pines and I.P.Grebennik.
Kristallografiya, Vol. 4, No. 1, 47-53 (1959). In Russian.

The coefficient of heterodiffusion was obtained from electron diffraction photographs on thin films of the alloys. For Cu–Ni and Fe–Ni a levelling up occurred of the concentrations in the two-layer film; in films of Cu–Al and Ag–Al a decomposition of supersaturated solid solutions was observed. Data on the effect of temperature on the heterodiffusion coefficient are given, and the activation energy calculated. R.F.S.Hearmon

539.2

13815. PENETRATION DEPTH AND THE DISTRIBUTION OF ATOMS INJECTED INTO A Si^{30} ISOTOPE TARGET.
M.I.Guseva, E.V.Inopin and S.P.Tsytko.
Zh. eksper. teor. Fiz., Vol. 36, No. 1, 3-9 (1959). In Russian.

The penetration depth and distribution of silicon injected into tantalum and copper backings were investigated. The targets, whic were prepared in an electromagnetic separator by direct precipita tion of the Si^{30} isotope on the backing were bombarded by protons accelerated in an electrostatic generator. The shape of the reson ance yield of γ-rays from a single γ-resonance in the $Si^{30}(p,\gamma)P^{3}$ reaction was observed in four targets and compared with the theor ical density distribution of the injected atoms. The penetration depth and nature of the distribution of the Si^{30} atoms injected into the tantalum backing satisfactorily agree with the theory.

539.217 : 541.

DIFFUSION-LIMITED GROWTH OF PRECIPITATE PARTICLES. See Abstr. 13879

539.21

13816. DISLOCATIONS OR PORES?
R.I.Garber, V.S.Kogan and L.M.Polyakov.
Fiz. Metallov. i Metallovedenie, Vol. 6, No. 5, 934-5 (1958). In Russian.

The authors compare the electron micrographs of thin Al film published by Hirsch, Horne and Whelan (Abstr. 2819 of 1957) with their own work on the polygonization of rock salt [Fiz. Metallov i Metallovedenie, Vol. 4, No. 1(10),89-93 (1957)]. In rock salt,coag tion of vacancies is observed on polygon walls, and on the publish evidence it may be that the spots observed by Hirsch et al. on mic graphs of Al could also be porosities and not dislocations.
A.F.Bro

539.2

13817. ATOMIC INTERACTION IN IRON–CHROMIUM ALLOY SYSTEMS. A.G.Lesnik.
Dokl. Akad. Nauk SSSR, Vol. 122, No. 3, 385-8 (1958). In Russian.

Using the Fe–Cr system as an example, the author shows tha the hypothesis of the formation of a polar state of the atoms in all enables us to interpret the main features of the phase diagram, including the separation of the σ-phase from the solid solution. I is postulated that some electrons are transferred from the B-ator to the A-atoms, thus giving rise to a Coulomb interaction. Becaus of the screening effect of the conduction electrons, only nearest neighbour interactions are taken into account in the calculation of Coulomb contribution to the configurational energy. Expressions are obtained for the free energies of formation of the various pha and the phase diagram is predicted on the basis of these. The res are compared with the experimental data and qualitative agreeme obtained. Values for the heats of formation of the alloys are also calculated. M.G.Priest

539.

13818. THE STRUCTURE OF A LIQUID AuSn ALLOY.
A.S. Lashko.
Dokl. Akad. Nauk SSSR, Vol. 125, No. 1, 126-8 (March 1, 1959). In Russian.

The author has investigated the structure of an alloy contain equal numbers of atoms of Au and Sn at a temperature about 10° above the melting point, by means of X-ray scattering. The scattered intensity and the radial distribution function are presen graphically. The results are interpreted as showing that about ha the atoms in the liquid preserve a short-range order similar to that which exists in the crystal, while the remainder have a dis-ordered arrangement with coordination number 10 and atomic separation 3.2 A. O.Penr

539.219 : 539.

13819. CERTAIN DENSITY AND MICROHARDNESS ANOMALIES IN Te–Se AND Te–S ALLOYS. V.N.Lange and A.R.Regel'.
Fiz. tverdogo Tela, Vol. 1, No. 4, 559-61 (April, 1959). In Russia

Density and microhardness minima were observed in Te–Se and Te–S alloys at compositions with 0.1 atomic % of Se or S. Se also the following abstract. A.Tybulew

539.219 : 537.311.

13820. ELECTRICAL ANOMALIES IN CONTINUOUS SOLID SOLUTIONS OF THE Te–Se AND Te–S SYSTEMS.
V.N.Lange and A.R.Regel'.
Fiz. tverdogo Tela, Vol. 1, No. 4, 562-4 (April, 1959). In Russia

When electrical properties of Te–Se and Te–S alloys are

ed against the amount of Se or S, they exhibit anomalies at
tomic % of Se or S. At this composition the electrical conduct-
and the hole mobility have maxima and the Hall constant has a
num. All these effects and the behaviour described in the
ding abstract are ascribed to formation of local defects, such
ancies and breaks in the Te–Te chains. A.Tybulewicz

539.219

CONTRIBUTIONS TO THE CHANGE IN KNIGHT SHIFT
N THE MELTING AND ALLOYING OF THE ALKALI METALS.
Driani.
em. Phys., Vol. 31, No. 2, 557-8 (Aug., 1959).
Considering melting process as composed of a change of volume
ed spatial and electronic configurations followed by a change in
configurations at constant volume, the contribution to the change
ight shift due to the first process is estimated from various
rimental data. This contribution is subtracted from the obs-
d values, together with the effect of the change in vibrational
trum with the change in configuration (estimated from a model).
remains is then the effect associated with the changes in the
ronic wave-functions produced by the loss of periodicity. It
not appear that this effect is related in a simple way to any
us electronic property of the metals. In alloying, the change
lume makes a negligible contribution. L.Pincherle

539.219

2. A NEW COMPOUND IN THE Au–Pb ALLOY SYSTEM.
jiki, R.Suganuma, and T.Yoshida.
hys. Soc. Japan, Vol. 13, No. 8, 969-70 (Aug., 1958).
A new tetragonal compound, probably $AuPb_3$, is found from
tron diffraction, X-ray and metallographic examination.
R.F.S.Hearmon

539.219

23. ELECTRON DIFFRACTION INVESTIGATION OF THE
UCTURE OF LIQUID METALS AND ALLOYS. A.I.Bublik and
.Buntar'.
stallografiya, Vol. 3, No. 1, 32-42 (1958). In Russian.
The method of obtaining the electron diffraction diagrams and
alculating the distribution function of the atoms is described.
a are given on the temperature dependence of the structure of
liquid metals Sn, Al, Bi, In, and of the liquid alloys Al–Sn,
-In and Bi–Sn at different concentrations and temperatures.
also Abstr. 2855-6, 5695 (1958). R.F.S.Hearmon

539.219

24. SHORT-RANGE ORDER AND CHARACTERISTIC
MPERATURE OF THE ALLOY Ni_3Pt. V.I.Iveronova and
.Katsnel'son.
stallografiya, Vol. 4, No. 1, 25-9 (1959). In Russian.
Parallel measurements were made by X-ray methods of short-
ge order, calculated from the diffuse scattering, and Debye
racteristic temperature, calculated by a method of least squares
m the ratio of intensities of lines in the X-ray diagram taken at
m and at low temperatures. The changes in characteristic
perature following plastic deformation are not associated with
responding changes in short-range order, due to the fact that
rt-range order in alloys such as Ni_3Pt is probably connected
h the presence of imperfections in the lattice of the deformed
y. See also Abstr. 2026 (1945). R.F.S.Hearmon

539.232

25. ELECTRON MICROSCOPICAL INVESTIGATION OF
LECTROLYTICALLY FORMED OXIDE FILMS FROM SILICON.
Politycki and E.Fuchs.
Naturforsch., Vol. 14a, No. 3, 271-5 (March, 1959). In German
Films formed on silicon by anodic oxidation can be removed by
posure in a stream of dry HCl at high temperature, and may be
epared thin enough for electron microscopy in transmission.
lms obtained with boric acid as electrolyte are composed of two
ers, one of which is highly porous, and are similar to the
loxal" films formed on aluminium. The pore diameter is between
0 and 200 A. Pore-free films could only be obtained if a non-
ueous electrolyte was used, such as methylacetamide, or in sodium
droxide. A thinner oxide film, also pore-free, was formed by
emical polishing or simply by exposure to air.
V.E.Cosslett

539.234

26. THE PROBLEM OF THE MECHANISM OF CONDENSA-
ON OF METALS IN VACUO. L.S.Palatnik and Yu.F.Komnik.
Dokl. Akad. Nauk SSSR, Vol. 124, No. 4, 808-11 (1959). In Russian.
Gives a short analysis of previous work, which suggests two distinct explanations of the mechanism: (a) the formation of twin crystals; (b) the formation of "twin liquid" particles which are the basis for further condensation. Describes an experimental investigation of the condensation of Bi vapour observed on a glass sheet with a temperature gradient (20° to 250° C). At temperatures $T < T_{k_1}$ crystallization occurs; at $T_{k_1} < T \leq T_{k_2}$ condensation through liquid phase occurs, where T_{k_1} and T_{k_2} are "critical temperatures" whose dependence on the pressure of Bi vapour was also investigated. Fifteen references. J.M.Zarzycki

539.234

13827. DENSITY MEASUREMENTS OF SOME THIN COPPER FILMS. N.Wainfan, N.J.Scott and L.G.Parratt.
J. appl. Phys., Vol. 30, No. 10, 1604-9 (Oct., 1959).
Density measurements have been made on vacuum-deposited copper films in the thickness ranges from 50 to 150 A and from 500 to 1000 A. To obtain the density, an analysis was made of the relation between the reflection coefficient and the glancing angle of incidence for 1.54 A X-rays. For films in the range from 500 to 1000 A, this analysis was augmented by a chemical determination of the average mass per unit area. Although there is evidence of non-uniform density with depth in the film, especially for the very thin films, the average density of a film thicker than about 300 A was found within the limits of the experimental accuracy to be equal to the bulk density. This conclusion is in agreement with some previously published work; the discrepancy appears to lie in differences between the X-ray method of measuring film thickness and the conventional optical interference method.

539.234 : 535.39

13828. STRUCTURE AND REFLECTIVITY OF GERMANIUM FILMS PREPARED BY VACUUM EVAPORATION.
S.Robin-Kandare, H.Damany and L.Tertian.
J. Phys. Radium, Vol. 20, No. 5, 569-70 (May, 1959). In French.
Ge layers evaporated from a graphite boat heated by a non-focused electron stream have relatively little contamination from the boat. If deposited on substrates at temperatures above 400° C the layers are crystalline with growth axes [110] or [100]. Reflectivity measurements were made on layers of thickness 2000-3000 A and deposited at 520° C, the spectral range 1000-3000 A being covered. The general form of results was similar to those of Gebbie but maxima were observed at 6.3, 5, and 4.4 eV, possibly arising from inter-band transitions. C.A.Hogarth

539.234

13829. ADHESION OF EVAPORATED ALUMINIUM FILMS.
C.Weaver and R.M.Hill.
Phil. Mag. (Eighth Ser.), Vol. 3, 1402-10 (Dec., 1958).
The increase in adhesion obtained for aluminium films by the pre-deposition of films of chromium is investigated, using Heavens' method of adhesion testing. It is found that the adhesion varies with the thickness of the chromium film, and with time. The variation with time suggests that the nature of the increase in adhesion is primarily one of alloying at the metallic interface, and subsequent age-hardening.

539.234

13830. THE DEPENDENCE ON TEMPERATURE OF THE GRANULATION OF THIN FILMS OF GOLD.
N.Croitoru, A.Dévényi and G.Ciobanu.
Rev. de Physique (Bucarest), Vol. 4, No. 1, 39-47 (1959). In French.
Evaporated gold films were examined by electron microscopy, and their electrical resistance and thickness were also measured, the latter by optical transmission. The observations were made at different temperatures and it was found that heating caused granulation of all films less than 180 A in thickness. Below 25 A granulation took place even at room temperature. Various other incidental phenomena were also noted. J.Thewlis

539.26

13831. STRUCTURAL PARAMETER DETERMINATION OF SMALL AROMATIC SYSTEMS IN NON-CRYSTALLINE SOLIDS. W.Rutland.
Acta cryst., Vol. 12, Pt 9, 679-82 (Sept., 1959).
The diffuse X-ray scattering from three non-crystalline polymers containing small aromatic ring systems was investigated using Diamond's least-squares method [Acta cryst., Vol. 11, No. 3, 129 (March, 1958)]. The structural parameters obtained, "amorphous content", aromatic size distribution, mean layer size and

mean bond length, are on the whole in good agreement with the theoretical values. The effect of deviations from an ideal aromatic system on the structural parameters is discussed.

539.26

13832. NATURE OF EXTINCTION IN METAL POWDERS. D.Batsur', V.I.Iveronova and G.P.Revkevich.
Kristallografiya, Vol. 4, No. 2, 214-18 (March-April, 1959). In Russian.

In copper and nickel powders, deformed and annealed below the recrystallization temperature, extinction of X-rays is of the secondary kind, whereas after high-temperature annealing above the recrystallization temperature, the extinction is primary. These results are explained in terms of changes in the grain and block structure in the powders. R.F.S.Hearmon

539.27

13833. IMPROVED SEMIAUTOMATIC HISTOGRAM PLOTTER. R.H.Kelsey and E.E.Hanson.
J.appl. Phys., Vol. 30, No. 10, 1513-15 (Oct., 1959).

An improved instrument for constructing particle size distribution diagrams from electron micrographs is described. Its use permits the measurement of large numbers of particles rapidly, and with low observer fatigue. The magnification of the image to be measured may be chosen to make the instrument error less that the resolution of the electron microscope. The device consists if a measuring unit in the form of a pair of dividers, controlling a servo system which automatically classifies the particles and plots the histogram as an array of steel balls in a slotted matrix. Adjustments for zero and span are provided, and the total number of particles measured is recorded.

539.27

13834. FORBIDDEN REFLECTIONS AND INTENSITY ANOMALIES IN THE KIKUCHI DIAGRAM OF SILICON. H.Ehinger.
Naturwissenschaften, Vol. 46, No. 15, 472 (1959). In German.

Some observations on the (hhh) orders are described. A.R.Stokes

539.27

13835. IMPROVED METHOD OF ETCHING BY ION BOMBARDMENT. T.K.Bierlein and B.Mastel.
Rev. sci. Instrum., Vol. 30, No. 9, 832-3 (Sept., 1959).

The method incorporates v.h.f. excitation to increase ionization and permits etching of specimens at pressures as low as 1 μ Hg. Suitable surfaces are thus produced for optical and electron microscope examinations. B.T.M.Willis

539.27

13836. ELECTRONMICROSCOPIC OBSERVATIONS OF ALKALI HALIDE CRYSTALS. T.Tomiki.
J. Phys. Soc. Japan, Vol. 14, No. 3, 304-7 (March, 1959).

A technique for making a sheet replica, in which two surfaces are cast simultaneously, is described. This was successfully applied to alkali halide crystals, which were rubbed gently with velvet or which were irradiated either with X-rays or with u.v. light. Using such a replica, it was possible to examine the effects induced by these treatments inside the crystal, just beneath the outer surface. It was also possible to measure with precision the depth of influence of the treatments. The results obtained are discussed.

539.27

13837. HIGH RESOLUTION ELECTRON MICROSCOPY OF CRYSTALS. G.A.Bassett, J.W.Menter and D.W.Pashley.
J. photogr. Sci., Vol. 7, No. 3, 60-5 (May-June, 1959).

It is now possible to resolve the basic periodicity of the arrangement of atoms or molecules in crystal lattices using the electron microscope. Examples are given of lattices resolved directly (including superlattices), and indirectly (by means of moire patterns) and of other periodic phenomena associated with crystal lattices (domains in ordered alloys). The basic principles of image formation in periodic objects are considered in terms of simple diffraction theory and some indications given of limiting factors in this type of investigation.

539.27

13838. A NOTE ON DIRECT OBSERVATION OF DISLOCATIONS BY ELECTRON MICROSCOPY. H.Hashimoto and T.Naiki.
J. Phys. Soc. Japan, Vol. 13, No. 7, 764-5 (July, 1958).

It is suggested that a series of through-focus photographs are necessary to distinguish true dislocations from ghosts in electron microscopy. Ghost disloations are observed in out-of-focus photographs of plane gratings illuminated by visible light and covered with transparent paper simulating the uneven layer of contamination due to electron irradiation; these ghost dislocations disappear at the focusing position. B.T.M.Will

539.2

13839. METHOD FOR MAKING DISLOCATIONS VISIBLE IN ELECTRON MICROSCOPY. H.Bethge and V.Schmidt.
Z. Naturforsch., Vol. 14a, No. 3, 307-9 (March, 1959). In German.

The etching methods used to show up dislocations in the optical microscope are unsuited to electron microscopy, since they obscure fine structure. Better results are obtained by evaporating, for example, NaCl on to a cleavage face of rock salt in high vacuum. A film some $10^3 - 10^4$ A thick is evaporated at a rate of 100-300 A/sec on to a surface heated to about 300°, this temperatu being fairly critical for the correct surface mobility. After cooling the crystal, but without breaking the vacuum, a carbon film is evaporated on to it. This replica is removed by solution and shadowcast with thallium fluoride, for observation in the electron microscope. Micrographs are shown (at 4800-1300 ×) of dislocatio arrays, including a twist boundary and more complicated "cleavage structures". The method is now being applied to germanium. V.E.Cosslett

539.2

13840. CINEMATOGRAPHY OF THE MOVEMENT OF LATTICE DEFECTS IN GOLD CRYSTALS. H.Poppa and K.J.Schulze.
Naturwissenschaften, Vol. 46, No. 12, 398-9 (1959). In German.

Movements of stacking faults and dislocations were observed with a Siemens-Elmiskop I electron microscope. The crystals we viewed in transmission and grew in a spiral form, so that the dislocations were also visible as rotation moiré patterns. B.T.M.Wil

539.2

13841. DIRECT OBSERVATION OF OPTICAL VIBRATIONS OF A CRYSTAL LATTICE OF A SOLID BY MEANS OF NEUTRON SCATTERING. P.Chentsov.
Uspekhi fiz. Nauk, Vol. 66, No. 2, 347-8 (Oct., 1958). In Russian. English translation in: Soviet Physics—Uspekhi (New York), Vol. 66(1), No. 1, 165-6 (Sept.-Oct., 1958).

The results of neutron scattering measurements on single crystal Ge and polycrystalline ZrH (Abstr. 2641-2 of 1958) are summarized. J.Frank

ELASTICITY . STRENGTH . RHEOLOGY

539.3

13842. STRESS–STRAIN ISOTHERM FOR POLYMER NETWORK A.Ciferri and P.J.Flory.
J. appl. Phys., Vol. 30, No. 10, 1498-507 (Oct., 1959).

According to the molecular theory of rubber elasticity, the stress τ is related to the relative length α in simple extension according to

$$\tau = kT(\nu/V)\langle\alpha\rangle^2(\alpha - 1/\alpha^2),$$

where $(\nu/V)\langle\alpha\rangle^2$ is a parameter of the network structure. Improve agreement with experiment has been claimed through use of the relation

$$\tau = (2C_1 + 2C_2/\alpha)(\alpha - 1/\alpha^2)$$

which contains the additional parameter C_2. In order to explore factors affecting this theoretically inexplicable term, stress–elongation measurements were performed on networks prepared from natural rubber, butyl rubber, poly-(dimethylsiloxane), poly-(ethyl acrylate), and poly-(methyl methacrylate) under a wide rang of experimental conditions. Results may be summarized as follow (1) the C_2 term offers improved agreement over the extension phas of an elongation cycle, but not for the subsequent retraction phase, (2) apparent values of C_2 (determined on extension) vary widely from one polymer to another, increasing with hysteresis and with proximity to the glass transition temperature; (3) they are insensitive to the degree of cross linking; (4) C_2 is markedly reduced by permanently swelling the network with a diluent, or by swelling and de-swelling the sample at each tension; (5) incorporation of diluent

r to establishing a network by cross linking with gamma radia-
likewise lowers C_2, the value characteristic of the unswollen
ner being restored upon removal of the diluent. The results
onstrate that the controversial C_2 term arises from the difficulty
taining elastic equilibrium; under ideal experimental conditions
alue of this parameter becomes negligible. An alleged limita-
of the theory of rubber elasticity is thus refuted.

539.32

3. A NOTE ON THE ELASTIC CONSTANTS OF URANIUM.
Cothman and E.S.Fisher.
STIC CONSTANTS OF POLYCRYSTALLINE URANIUM.
Laquer.
ear Sci. Engng, Vol. 5, No. 3, 195-6, 197-9 (March, 1959).
The elastic constants of polycrystalline uranium are calculated
recently obtained single-crystal data. These values are com-
d with widely different results obtained by three different ob-
ers using material which had been quenched from the β-phase
which according to R. and F. should show isotropic behaviour.
rticular Laquer's results on a single specimen are shown to be
what different from the calculated values and it is suggested
the discrepancy arises possibly from errors in measuring
nique or from structural defects such as microcracks. Laquer
s out that R. and F. have selected only one set of his data
nave neglected other results on specimens of different
llurgical history, e.g. cold swaged and annealed at 600°C, γ-
ded and cast, which agree well with the calculations of R. and
ven some uranium-rich alloys give good agreement. Abnorm-
low values for the moduli are obtained on specimens which have
water-quenched from the β-phase, but after an anneal at 600°C
hours the normal values are obtained. This behaviour is not
rstood. A.E.Kay

539.32

4. THE VARIATION IN INTERNAL FRICTION IN SILVER.
de.
aturforsch., Vol. 14a, No. 8, 762-3 (Aug., 1959). In German.
A torsion pendulum was used to test silver specimens at 203°C
t a frequency of 0.2 c/s. That part of the internal friction
ndent on amplitude, Q_A^{-1}, was determined from the measurements
after deflection to a specific amplitude measured on the
mference of the twisted wire. Q_A^{-1} initially did not vary with
naximum torque up to a certain limiting value, beyond which it
eased markedly with torque. When plotted in the form of log Q_A^{-1}
us the maximum torque employed in each test, it gave curves
lar in form to those obtained by Granato and Lücke, but not
ly so steep. It was deduced from this that only about 5 per cent
e change of damping with torque was due to parallel slip.
A.C.Whiffin

539.37

5. THE PHENOMENON OF ARTIFICIAL DISPLACEMENT
MATION. VII. INVESTIGATION OF ARTIFICIAL DISPLACE-
T FORMATION DURING ROUND BENDING.
Lange and A.V.Stepanov.
tverdogo Tela, Vol. 1, No. 4, 666-70 (April, 1959). In Russian.
This paper is a continuation of others published by the second
e authors [Zh. eksper. teor. Fiz., Vol. 17, 601 (1947); Abstr.
of 1948; Abstr. 1227 of 1949; Zh. eksper. teor. Fiz., Vol. 18,
1948); Abstr. 1304-5 of 1952]. The effects of artificial displace-
are studied under nonuniform stresses resulting from round
ing. The effects of the direction of stress on the optical elastic
of artificial displacement are discussed as well as these
ts on the direction of axis of optical ellipsoid during the change
e direction of stress. J.K.Skwirzynski

539.371

6. STATISTICAL THEORY OF STRAINS IN METALS.
.Strunin.
. Akad. Nauk SSSR, Vol. 125, No. 4, 790-3 (April 1, 1959).
ussian.
A proposed mathematical model permits, in terms of a
stical parameter, to analyse the behaviour (i.e. to determine the
ance of strains or other conditions in suitably fixed elements
standard volume)of real substances under arbitrary stressing
itions, when the overall stresses are assumed to be in the
r range. This statistical treatment allows to determine the
ersion of the strain potential energy as a function of the degree
astic deformation as well. The value of that energy is found
he break-up conditions. J.K.Skwirzynski

539.373

13847. GRAIN-BOUNDARY EXTRUSION AND DEFORMATION DURING THE FATIGUE OF LEAD IN A PARTIAL VACUUM.
K.U.Snowden.
Phil. Mag. (Eighth Ser.), Vol. 3, 1411-12 (Dec., 1958).
Observations have been made of slip, grain-boundary migration and grain-boundary extrusion during the fatigue of high purity lead in vacuo (approx. 5×10^{-3} mm Hg).

539.374

13848. EFFECT OF ADSORBED WATER ON THE VISCOELASTIC PROPERTIES OF NYLON 6. T.Nakajima.
Bull. Kyushu Inst. Technol. (Math. nat. Sci.) No. 4, 21-7 (March, 1958).
Measurements of the temperature dependence of dynamic shear modulus G' and loss modulus G'' were made on various samples with adsorbed water, in order to investigate the effect on the viscoelastic properties of crystalline polymers.

539.374

13849. THE RELATIONS WHICH DETERMINE PLASTIC FLOW UNDER TRESCA'S PLASTICITY CRITERION AND ITS GENERALIZATIONS. D.D.Ivlev.
Dokl Akad. Nauk SSSR, Vol. 124, No. 3, 546-9 (Jan. 21, 1959).
In Russian.
In a previous paper [Prikladnaya matematika i mekhanika, Vol. 22, No. 1 (1958)], the author examined the system of equations for the stress field in a fully plastic region (i.e. where two yield conditions are satisfied simultaneously). It is verified here that the associated system determining the flow field has identical characteristics, for the Tresca criterion and for two formal generalizations of it. I.D.C.Gurney

539.374

13850. A METHOD FOR SOLUTIONS OF ELASTICITY EQUATIONS. I.I.Vorovich and Yu.P.Krasovskii.
Dokl. Akad. Nauk SSSR, Vol. 126, No. 4, 740-3 (June 1, 1959).
In Russian.
The method described is suitable for determination of small elasto-plastic deformations, without any initial limitations on the magnitude (smallness) of parameters. Two general cases are studied: (a) for vanishing displacements at the boundaries; (b) for assumed distribution of body forces at the boundaries.
J.K.Skwirzynski

539.374

13851. SOLUTIONS FOR SMALL ELASTO-PLASTIC DEFORMATIONS IN PLANE MEDIA. Yu.P.Krasovskii.
Dokl. Akad. Nauk SSSR, Vol. 126, No. 5, 961-3 (June 11, 1959).
In Russian.
Application of the method of solution described previously (see preceding abstract) for the particular case of a two-dimensional plane medium. J.K.Skwirzynski

539.374

13852. LIMITING EQUILIBRIUM OF AN INHOMOGENEOUS PLASTIC WEDGE. B.A.Druyanov.
Dokl. Akad. Nauk SSSR, Vol. 127, No. 5, 990-2 (Aug. 11, 1959).
In Russian.
The author considers the deformation of a two-dimensional plastic wedge, loaded along one side only. The locus of fluidity is obtained by quadrature, in terms of the polar angle of the wedge. This leads to determination of approximate formulae for stresses in inhomogeneous wedges and hence to equilibrium conditions.
J.K.Skwirzynski

539.374

13853. BENDING OF SMALL ZINC SINGLE CRYSTALS. C.T.Wei.
J. appl. Phys., Vol. 30, No. 9, 1457-8 (Sept., 1959).
Rectangular single zinc crystals with the basal plane parallel to the longitudinal axis are ductile after etching to approx. 200 μ thickness and were bent plastically about a [10$\bar{1}$0] axis, up to 20% strain, repeatedly with no evidence of mechanical twinning.
J.E.Caffyn

539.374

13854. PHENOMENOLOGICAL THEORY OF [NONLINEAR] VISCO-ELASTICITY OF THREE DIMENSIONAL BODIES.
M.Yamamoto.
J. Phys. Soc. Japan, Vol. 14, No. 3, 313-30 (March, 1959).
The authors start from the two elementary models of the

classical linear theory of visco-elasticity, i.e. Maxwell and Voigt models. These models are extended to the three dimensional non-linear case by adopting the energy consideration. The three-dimensional Maxwell model is defined by "series connection" of a "non-Hookeian spring", i.e. the internal elastic mechanism and a "non-Newtonian dashpot", the energy dissipation mechanism; the three-dimensional Voigt model is represented by the "parallel connection" of these mechanisms. Making use of the Maxwell model, the tensile viscosity is discussed for the stationary simple elongation of elastico-viscous liquids. The present models are shown to be successful in analysing normal stress effects, i.e. the Weissenberg effect for elastico-viscous liquids and the Poynting effect for visco-elastic solids. The nonlinearity in visco-elastic properties is classified into elastic, viscous or relaxational, and geometric non-linearities. An essential feature of the three dimensional bodies is the geometric nonlinearity.

539.374 : 548.5

13855. THE MECHANISM OF PLASTIC DEFORMATION IN ROCK SALT CRYSTALS. M.P.Shaskol'skaya and Sun' Zhui-Fan.
Kristallografiya, Vol. 4, No. 1, 74-80 (1959). In Russian.

The surface relief of the lateral boundaries of rock salt crystals subjected to homogeneous shear and extension was studied by a micro-interferometer method and correlated with the existence of doubly refracting bands in the deformed crystal. In the initial stages of plastic deformation the doubly refracting bands indicate slip, each band corresponding with a step on the lateral surface. On one side of the band the crystal is in tension and on the other side it is in compression; the double refraction is caused by these residual stresses. See also the three abstracts following.
R.F.S.Hearmon

539.374 : 548.5

13856. ETCH AND DISLOCATION FIGURES ON DOUBLY REFRACTING BANDS IN [PLASTICALLY DEFORMED] ROCK SALT CRYSTALS. M.P.Shaskol'skaya and Sun' Zhui-Fan.
Kristallografiya, Vol. 4, No. 1, 81-4 (1959). In Russian.

It is found that etch figures in plastically deformed rock salt crystals are arranged in regular rows corresponding to bands of double refraction. This supports the suggestion that the doubly refracting bands are slip bands and are created by trapped dislocations. Evaluation of the number of etch figures and the slip difference on opposite sides of the crystal allows the suggestion of a well-defined mutual correspondence between etch figures and dislocations to be tested qualitatively. R.F.S.Hearmon

539.374 : 548.5

13857. DETERMINATION OF MICRO-DISTORTIONS IN SLIP BANDS OF ROCK SALT. V.I.Startsev and P.M.Aronova.
Kristallografiya, Vol. 4, No. 1, 85-9 (1959). In Russian.

X-ray diffraction measurements were made at room and at liquid oxygen temperatures on undeformed specimens of rock salt and on specimens taken from regions adjoining slip bands in deformed crystals. The Debye temperature was calculated from the ratio of intensities of lines at the two temperatures; the value obtained for undeformed specimens agreed well with the specific heat value. The Debye temperature in the deformed specimens was about half the undeformed value, indicating a weakening of the forces between individual atoms in the lattice. The static displacement of atoms distant from the slip bands was also measured.
R.F.S.Hearmon

539.374 : 548.5

13858. WHAT ARE "IRRATIONAL TWINS"?
V.L.Indenbom and A.A.Urusovskaya.
Kristallografiya, Vol. 4, No. 1, 90-100 (1959). In Russian.

A theoretical and experimental investigation has been made of the type of deformation of NaCl crystals discovered by Brilliantov and Obreimov (1937), which leads to the formation of "irrational twins". The conception of a translational mechanism of lattice reorientation in "twins" is supported by results of selective etching, and also by optical polarization, X-ray and interferometric examination of NaCl and LiF crystals. It is shown that in deformed crystals of the NaCl type, any difference in the choice of preferred slip elements in different parts of the specimen must lead to the formation of differently orientated regions possessing all the basic properties of "irrational twins". There is a theoretical appendix "Stress and lattice rotation in the presence of surface distribution of dislocations arising during the plastic deformation process".
R.F.S.Hearmon

539.374

13859. NEW POINTS OF VIEW ON THE PROBLEM OF THE ELASTO-PLASTIC EQUILIBRIUM IN TIME. I. G.Colonnetti.
R.C. Accad. Naz. Lincei, Vol. 25, No. 3-4, 140-5 (Sept.-Oct., 1958). In Italian.

If the external forces start acting at t = 0, the deformation at t is written as the sum of an elastic part $\epsilon(t)$ and a plastic part $\bar{\epsilon}(t) = \int_0^t \epsilon(t) f(t) dt$ where f(t) is a "coefficient of plasticity". The special case is studied of f = constant and of applied forces increasing linearly with time; then this variation is assumed to change sign abruptly at a certain time. When the external force is again reduced to zero, half the plastic deformation remains. L.Pincherle

539.383 : 532.12

13860. FLOTATION METHOD OF MEASURING COMPRESSION COEFFICIENTS OF HARD SUBSTANCES AND LIQUIDS.
B.P.Konstantinov, Yu.M.Baikov and G.Ya.Ryskin.
Fiz. tverdogo Tela, Vol. 1, No. 6, 963-9 (June, 1959). In Russian.

This method of measurement, suggested by the authors previou (Abstr. 312 of 1957), is discussed here again; basic formulae are derived, measurement techniques described in detail and some results are tabulated (e.g. for NaCl crystals). J.K.Skwirzynsk

539.

13861. THE STRESSES PRODUCED IN A THIN ELASTIC PLATE BY A TRANSVERSE IMPULSIVE FORCE. C.J.Maiden.
Phil. Mag. (Eighth Ser.), Vol. 3, 1413-23 (Dec., 1958).

A description is given of tests in which a $\frac{1}{2}$ in. or $\frac{3}{8}$ in. diamete weighbar, seated vertically on a thin steel plate, was impacted by a finite mass. The force applied to the plate and the principal stress produced at the bottom of the plate have been derived from the output of resistance strain gauges. The stress—time curves at the centre of the bottom surface of the plate, obtained at a number of impact velocities, have been compared with stress—time curves derived from theoretical considerations. The agreement between the theoretical and experimental results is found to be exceedingly good. In such tests the plate showed no sign of having yielded even though the stresses reached were much greater than the static upper yield stress of the steel in the plate. This is attributed to the fact that strain rates of the order of 100 sec^{-1} were attained in the plate in these tests. The manner in which the disturbance created in this type of test was propagated radially has been determined from the way the principal stresses, at the bottom of the plate, varied with radius and time. It is found that there was an annular area of compression which propagated radially in advance of a central area of tension. Tests have also been made in order to determine the manner in which a disturbance caused by an impulsive point load propagates radially in a plate. A dural and a steel plate were impacted by a high-tensile steel sphere and the principal stresses produced at the bottom surface of the plates were once again determined from the output of strain gauges. It is found that the disturbances produced in these tests propagated in a similar manne to the way the disturbances propagated in the tests in which the for was applied over a finite area.

539.4.016.

13862. DIMENSIONAL ALTERATIONS AS A CONSEQUENCE OF COLD-WORK. K.Wagner.
Z. angew. Phys., Vol. 11, No. 5, 174-8 (May, 1959). In German.

The alteration in length of a Cu test piece was measured by an interferometric method. The effect was found, at room temperatur to proceed logarithmically with time, the constant of proportion depending only on the final stress. J.Thewli

539.4

13863. BRITTLE RUPTURE OF PURE AND ALLOYED ZINC SINGLE CRYSTALS.
L.A.Kochanova, I.A.Andreeva and E.D.Shchukin.
Dokl. Akad. Nauk SSSR, Vol. 126, No. 6, 1304-7 (June 21, 1959). In Russian.

Measurements of tensile stress at rupture were made as a function of orientation on three Zn samples of different purity, and on Zn samples containing 0.2 and 0.5% Cd. The measurements were made on unamalgamated specimens at −196°C and on amalgamated specimens at 20°C. The results are interpreted in the light of the authors' theory, according to which the quantity $P_C(\sin^3\chi_1 \cos\chi_1)^{1/2}$ should be constant, where P_C is the true tensile stress, and χ_1 is the angle between the specimen axis and the (0001) plane. The results of Deruyttère and Greenough [J. Inst. Metals, Vol. 84, Pt 9, 337-45 (May, 1956)] are also re-examined in terms of the theory. R.F.S.Hearmo

539.42 : 539.19

4. THEORY OF MECHANICAL BREAKDOWN AND MOLECR ORIENTATION OF A MODEL LINEAR HIGH-POLYMER SOLID.
. Hsiao.
ppl. Phys., Vol. 30, No. 10, 1492-7 (Oct., 1959).
A phenomenological theory of the molecular orientation depene of mechanical breakdown phenomena is presented for a model ar high polymer solid. Taking into account the variation of the me a general microscopic molecular model is first introduced. r simplification an approximation is considered. For one-ctional orientation the result indicates a rapid increase in the ture strength as the degree of molecular orientation increases. maximum fracture strength is found to increase to nearly six s the unoriented strength.

539.431

35. ON THE MECHANISM OF INCREASE OF FATIGUE ENGTH OF ELASTOPLASTIC MATERIALS, WHICH TEND TO ASTIC STABILITY ON CYCLIC DEFORMATION, WHILE UNDER LUENCE OF STRONG SURFACE-ACTIVE SUBSTANCES.
I Chaevskii.
l. Akad. Nauk SSSR, Vol. 125, No. 2, 319-22 (1959). In Russian.
Work previously reported by the author and by Rebinder, on tic effects of surface-active substances (like steel with a Sn alloy), is more fully discussed here from the point of view he fatigue effects on cyclic deformation, as exhibited by the pes of elastic hysteresis. J.K.Skwirzynski

539.434

66. A THEORY OF THE CREEP IN METALS, INCLUDING RENGTHENING AND RECOVERY. P.Täubert.
andl. Dtsch. Akad. Wiss. Berlin. Kl. Math. Phys. Tech., 1959, 7, 59 pp. In German.
The comparison of various results obtained from the study of ep and a critical examination of existing theories (of Mott, arro, Frank, etc.), ledthe author to a new way of describing the ep phenomenon: it is considered here as a reaction between the engthening and the recovery, following a deformation. Both these nomena are basically caused by thermal processes and these are en into account during the formulation of the complete system of iations. The author shows that the exhaustion theory, used up to to describe transient creeps, enters into the solution of his iations as a special case. However, when the recovery effect is lected, both theories coincide. They also produce the same ep curves when the distribution function of the sources, construcaccording to the exhaustion theory, is equated to the integral r the distribution function obtained by the author's method. The tribution function cannot be measured directly and thus the new thod avoids many difficulties which prevent full understanding of exhaustion theory. The complete treatment of the creep formaallows for establishing conditions under which the recovery can neglected. On the other hand, presence of recovery allows, ong others, for derivation of a closed expression for the speed of ep boundaries. Finally, the question of spontaneous dilatation also considered by means of a special model, and it is shown t at low temperatures, the quantum effects do not influence the sults of the theory. J.K.Skwirzynski

539.434

867. THE EFFECT OF OXIDE LAYERS AND OF [IMMERSION] ADSORPTIVE [SURFACE]-ACTIVE SUBSTANCES ON THE REEP OF COPPER WIRE.
S.Ostrovskii, T.A.Amfiteatrova and B.Ya.Yampol'skii.
kl. Akad. Nauk SSSR, Vol. 122, No. 4, 643-5 (1958). In Russian.
It is known that single crystals of metals and polycrystalline res are hardened by oxide layers. Experiments were made to vestigate the hardening or softening effect of liquids in which pper wires were immersed during straining. It was found that the te of creep was reduced by immersion in pure water or in 3% drogen peroxide. On the other hand, the rate of creep was ineased by a dilute solution of butyl-alcohol in water and by 1% drogen peroxide. In explaining the different effects of hydrogen roxide it is assumed that the oxide is sometimes formed as a m and sometimes as a set of incoherent spots.
R.Eisenschitz

539.501 : 532.517

HELICAL FLOW OF GENERAL FLUIDS. See Abstr. 13053

539.53 : 539.219

MICROHARDNESS ANOMALIES IN Te—Se AND Te—S ALLOYS. e Abstr. 13819

539.576 : 621.92

13868. THE PHYSICS OF ULTRASONIC MACHINING OF SOLID MATERIALS. L.D.Rozenberg and V.F.Kazantsev.
Dokl. Akad. Nauk SSSR, Vol. 124, No. 1, 79-82 (Jan., 1959). In Russian.
An abrasive boron carbide suspension (in water or glycerol) was placed in a very thin vessel the bottom of which consisted of the 0.1 mm thick edge of a cover glass; the working tool was a piece of a safety razor soldered to the end of a magnetostrictive rod vibrator. The process was recorded by means of high-speed (20 000-50 000 frames/sec) cinematography. Although the individual movements of the abrasive particles could be attributed to (1) the ponderomotive forces of the sonic field and to hydrodynamic currents; (2) shock waves produced during the annihilation of cavitation bubbles; and (3) mechanical impacts of the oscillating end of the tool, the removal of a glass particle was observed only when the tool effected a direct hit on an abrasive particle lying on the glass surface. Purely cavitational erosion of the tool was also observed.
F.Lachman

539.58

13869. THE DYNAMIC COMPRESSION OF PERSPEX.
J.S.Buchanan, H.J.James and G.W.Teague.
Phil. Mag. (Eighth Ser.), Vol. 3, 1424-31 (Dec., 1958).
High explosives were employed to generate intense shock waves in Perspex and from the measurements made of the shock and free surface velocities the 'Hugoniot' equation of state was determined within the pressure range from 3 to 13 $\times$ 10^{10} dynes cm^{-2}. The results fit an equation of an inverted Bridgman type. Graphs are given of the variation of pressure, shock and particle velocity with Perspex thickness.

539.62 : 531.43

13870. REDUCTION OF STATIC FRICTION BY SONIC VIBRATIONS. H.D.Fridman and P.Levesque.
J. appl. Phys., Vol. 30, No. 10, 1572-5 (Oct., 1959).
The effect of sonic vibrations on the coefficient of static friction was measured for highly polished, ground, and sand-pitted steel surfaces. The coefficient of static friction can virtually be reduced to zero as a result of increased vibrations at frequencies between 6 and 42 kc/s.

539.621

13871. ON MODEL STUDIES OF METALLIC SURFACE ASPERITIES. F.F.Ling and R.C.Lucek.
J. appl. Phys., Vol. 30, No. 10, 1559-63 (Oct., 1959).
An apparatus for measuring forces generated at the tips of two cones throughout the sliding-contact life cycle is described. The cones are used to simulate surface asperities. Test results under atmospheric conditions show the following. (1) For cones with 90° internal angles, the ratio of the integrated value of the horizontal force component over the length of the life cycle to that of the vertical force component, a measure of coefficient of friction after Green, is not sensitive to the presence of lubricants in cases where the cone tips are in line or nearly in line with the direction of relative motion; but the ratio is substantially lowered in the presence of lubricants when the cone tips are far from being in line with the direction of relative motion. The former cases are always accompanied by the formation of macroscopic wear debris. (2) By increasing the internal angle of cones, the ratio defined above is decreased, but its value does not seem to approach zero for the angle approaching 180°, a flat surface. (3) Size effect as discussed by Morrison and Shaw is evidenced in this experiment. The mutual inclusiveness of the classical interlock theory and the popular adhesion theory of friction is discussed. Moreover, the coefficient of friction for a pair of idealized surfaces with asperities in the form of 90° cones and randomly distributed is calculated from considerable amount of test data. While actual surfaces have asperities roughly in the form of cones with internal angles much larger than 90°, right circular cones were used, nevertheless, for simplicity and for amplifying the effects noted.

539.621

13872. WEAR DEBRIS IN THE CONTACT BETWEEN SLIDING METALS. M.Cocks.
J. appl. Phys., Vol. 29, No. 11, 1609-10 (Nov., 1958).
With clean copper on copper (μ = 1.1 to 1.4) the wear debris between a rotating cylindrical drum (6 in. diameter) and a hemispherically ended rider (0.125 in. diameter) forms a wedge, usually situated at the leading edge of the rider. This wedge forces the drum and rider apart. The separation becomes clearly visible after the first centimetre or two of sliding. From time to time the wedge breaks

away from the rider and is carried away on the drum surface. If a second rider follows in the same path, the wedge associated with it collects many of these fragments. The loose fragments falling from this second rider amount to about two to three times the weight of those falling from the first rider. The riders themselves are subject to wear only when wedges break away. Their weight loss is very small. It is conjectured that one function of a lubricant may be to prevent the growth of the wedges by inhibiting cohesion between the metal fragments. R.Schnurmann

539.89 : 536.421.1
FUSION CURVES FOR Fe, Ni, Pt AND Rh TO 10^5 ATM.
See Abstr. 13224

539.89 : 536.421.1
PHASE DIAGRAM OF RUBIDIUM TO 150 000 kg/cm^2.
See Abstr. 13223

PHYSICAL CHEMISTRY

PHASE EQUILIBRIUM
CHEMICAL REACTIONS

541.124 : 539.217
AN X-RAY INVESTIGATION OF THE KINETICS OF REACTION DIFFUSION IN THE SYSTEM Al—Sb. See Abstr. 13809

541.126
13873. INSTRUMENTED CARD-GAP OR SPHF-PLATE TEST.
M.A.Cook, D.H.Pack, L.N.Cosner and W.A.Gey.
J. appl. Phys., Vol. 30, No. 10, 1579-84 (Oct., 1959).

The deflagration to detonation transition (DDT) was studied by means of the shock-pass heat-filter (SPHF) method using Composition B donors in all cases and Composition B, HBX, and Baratol receptors. The SPHF plates were glass, steel, brass, and aluminum. The influence of donor charge diameter and length, and the receptor diameter on the sensitiveness limit, the curves of $S_1-\tau'$, and $S_2-\tau'$ were established for these conditions. A striking result is that S_2/τ' proved to be constant equal to the (effectively sonic) velocity if the initial (relatively) unreactive shock wave in the receptor prior to the DDT; it was independent of donor and receptor charge size, the SPHF plate thickness and type. Based on observation with nitromethane, Dithekite, and liquid TNT, the phenomenon that eventually initiates the DDT forms on the receptor surface of the SPHF plate as a luminous spot that then flashes effecting the DDT at the instant it collides with the (relatively) nonreactive shock front. The present results are entirely consistent with this mechanism, even though one does not observe the flash-across in the opaque solid explosives.

541.126
13874. ADVANCE DETONATION IN A TUBULAR CHARGE OF EXPLOSIVE. D.W.Woodhead.
Nature (London), Vol. 183, 1756-7 (June 20, 1959)

Detonation is accelerated in some solid explosions if cavities are present. In explosions of tubular charges, a luminous cavity wave travelling faster than the detonation is observed. In non-sensitive explosives, such as TNT, this cavity wave merely causes a loss of energy, but in sensitive explosions, such as 40 : 60 tetryl/TNT, it may initiate further detonation. Photographs of such effects are shown. Suitably designed cavities may be used to give a minimum time of detonation. A.G.Gaydon

541.126 : 534.222.2
CONDITIONS NEAR THE CENTRE OF AN EXPLOSION, GIVING RISE TO TWO SHOCK WAVES. See Abstr. 13095

541.126 : 534.222.2
TWO CASES OF UNSTABLE COMBUSTION. See Abstr. 13099

541.128
13875. EFFECT OF NEUTRON IRRADIATION ON THE ACTIVITY OF SILICA—ALUMINA CATALYST FOR THE DOUBLE BOND ISOMERIZATION OF BUTENE-1.
P.J.Lucchesi, D.L.Baeder, J.P.Longwell and M.C.Schroeder.
J. chem. Phys., Vol. 31, No. 2, 558-9 (Aug., 1959).

Irradiation has been shown to markedly reduce the catalytic activity of $SiO_2-Al_2O_3$ for this isomerization. Possible explanations for this change are (a) formation of impurities in the catalyst by nuclear transmutation, and (b) radiation-induced defects. G.I.W.Llewelyn

541.13 : 534.3
EFFECT OF ULTRASONIC WAVES ON ELECTROCHEMICAL CONCENTRATION GRADIENTS. See Abstr. 13115

PHOTOCHEMISTRY
RADIATION CHEMISTRY

541.1
13876. RADIATION-INDUCED REACTIONS IN THE $N_2-O_2-H_2O$ SYSTEM. A.R.Jones.
Radiation Research, Vol. 10, No. 6, 655-63 (June, 1959).

Electron bombardment of moist N_2-O_2 mixtures produced HNO_3 and N_2O. After complete removal of water, HNO_3 disappeared with formation of water and a stoichiometric amount of NO_2. After the HNO_3 had decomposed, NO_2 was produced at a lower rate and the total nitrogen fixation was decreased. Production and destruction of nitric acid, and formation of NO_2 from HNO_3, were linear functions of energy input. G values for all the reactions depended on O_2 concentration. C.B.Allsop

541.1
13877. ION—MOLECULE REACTIONS OF METHYL AND ETHYL IODIDES. R.F.Pottie, R.Barker and W.H.Hamill.
Radiation Research, Vol. 10, No. 6, 664-70 (June, 1959).

Ion—molecule reactions from CH_3I, C_2H_5I and their mixtures were studied in the mass spectrometer. Appearance potentials of the important primary ions and all secondary ions, and the reaction cross-sections, were measured and tabulated. C.B.Allsop

DISPERSIONS . COLLOIDS . ADSORPTION

541.18 : 539.2
13878. INVESTIGATION OF COLLOIDAL SYSTEMS FOR PARTICLE-SIZE AND POLYDISPERSENESS WITH THE HELP OF X-RAY SMALL-ANGLE SCATTERING. F.Motzkus.
Acta cryst., Vol. 12, Pt 10, 773-86 (Oct., 1959). In German.

With the object of testing the theory, small-angle X-ray scattering (filtered Cu radiation) was observed on polydisperse systems (carbon black, gold sol, polystyrene latex) of varying grades of packing density. Using the method of discussion proposed by Hosemann (1939, 1950) the average particle radius $\bar{\bar{x}}$ and the degree of polydisperseness g were determined for samples of different compaction. Electron microscope pictures of the samples were also taken and discussed statistically. Both $\bar{\bar{x}}$ and g values check with the X-ray values to within 6% in the case of latex and gold, whereas carbon black values differed. The effects of non-spherical particle shape, of multiple scattering and of in-phase scattering by different particles ("liquids maxima") are discussed and evaluated.

541.18 : 539.2
13879. DIFFUSION-LIMITED GROWTH OF PRECIPITATE PARTICLES. F.S.Ham.
J. appl. Phys., Vol. 30, No. 10, 1518-25 (Oct., 1959).

Diffusion-limited precipitation rates are calculated, using theoretical methods derived previously, for systems of precipitate

icles which may change shape as they grow. General formulae presented, including suitable short- and long-time approximas. Explicit growth laws are derived for systems in which icles are disks and rods subjected to various constraints. The wth exponenent n in the short-time approximation is found to be r disks of constant thickness. Rods of constant radius that ure atoms only near their ends have n = 1. Both disks and rods onstant ratio of their long and short dimensions have n = 3/2. se values contrast with growth laws suggested by Wert and er (1949 and 1950) for disks and rods, for which they found 5/2 and 2, respectively. It is shown that growth conditions at edge of a growing particle are not constant in diffusion-limited umstances if the entire surface of the particle acts as a sink.

541.183 : 537.311.33

THE CHARGING OF THE SURFACES OF OXIDE SEMINDUCTORS IN THE ADSORPTION OF GASES AND VAPOURS. Abstr. 13292

CHEMICAL ANALYSIS

545.8

80. AN ACOUSTIC METHOD OF GAS ANALYSIS. O.I.Kuchmin.
ist. Zh., Vol. 4, No. 3, 263-6 (1958). In Russian.
The method is based on a comparison of the phases of the nd emitter and of a sound receiver situated in a tube containing the gas mixture being analysed. The industrial possibilities of the method as to rapidity and adequacy of precision, are shown with O_2—N_2 mixtures as examples. [English translation in: Soviet Physics—Acoustics (New York), Vol. 4, No. 3, 268-7 (July-Sept., 1958)]. C.R.S.Manders

545.827

13881. QUANTITATIVE MASS SPECTROMETRIC DETERMINATION OF EXTREMELY SMALL ALKALI CONCENTRATIONS BY THE METHOD OF COMPLETE EVAPORATION.
H.Voshage and H.Hintenberger.
Z. Naturforsch., Vol. 14a, No. 3, 216-29 (March, 1959). In German.
By using an improved surface ionization source and the method of complete evaporation 10^{-12} g of caesium could be determined to an accuracy of 20%. Details of the source and the technique are given. T.Mulvey

545.827 : 537.534

13882. MASS-SPECTROMETRIC INVESTIGATIONS USING A FIELD-EMISSION ION SOURCE. H.D.Beckey
Z. Naturforsch., Vol. 14a, No. 8, 712-21 (Aug., 1959). In German.
Simpler mass-spectra may be obtained in chemical research when a field-emission ion source is used instead of the more usual electron-collision type. Construction of such a source with field strengths varying from 1 to 5×10^6 V/cm, based on Müller's ion-microscope, is described, as well as applications to the study of reactions of molecules with paired and unpaired electrons, molecular association and formation of condensed layers on the field-emitter, and formation of free radicals in chemisorptive and photochemical reactions. B.Meltzer

CRYSTALLOGRAPHY

548.1

83. THE RAY-REPRESENTATION OF CRYSTALLOGRAPHIC OUPS. W.Döring.
Naturforsch., Vol. 14a, No. 4, 343-50 (April, 1959). In German.
A system is proposed for the representation of crystal nmetry classes in terms of their electron waves functions, and example of its use is given. A.R.Stokes

548.2

384. MICROSCOPIC DETERMINATION OF ORIENTATION OF ALL CRYSTALLITES BY MEANS OF LIGHT FIGURES.
Andrä, H.Gengnagel and G.Elbinger.
urwissenschaften, Vol. 46, No. 7, 224-5 (1959). In German.
Reports useful results for an Fe-Al and a nickel ferrite stallite. E.P.Wohlfarth

548.24

85. ELECTRON OPTICAL INVESTIGATION OF TWIN RMATION IN EVAPORATED SILVER FILMS. L.Reimer.
ik, Vol. 16, No. 1, 30-4 (Jan., 1959). In German.
Silver films, formed by evaporation on to heated cleavage faces rock salt, are seen in electron micrographs to consist of isolated stallites a few hundred Angstrom units in diameter. Some of se crystallites show cross-striations which change in contrast, not in position, on tilting the specimen with respect to the elecn beam, so that they cannot be extinction contours. By means of ctron diffraction, they are shown to be due to twin formation. They e the same type of satellite structure around the primary diffrac- spot as originally observed by Brück (Abstr. 2977 of 1936), and lained on the basis of twin formation by Cochrane (Abstr. 4473 of 6). V.E.Cosslett

548.5

86. THE EPITAXIAL RELATIONSHIPS IN CUPROUS OXIDE RMED ON COPPER SINGLE CRYSTALS IMMERSED IN AN UEOUS SOLUTION OF COPPER SULFATE.
.Lawless and G.T.Miller, Jr.
a cryst., Vol. 12, Pt 8, 594-600 (Aug., 1959).
These relationships were determined by means of electron raction and electron microscope techniques. The copper surs were carefully prepared by electropolishing and were found e free of facets or irregularities down to the limit of resolution of the electron microscope and replica techniques (~ 20 A). On the five faces studied, (001), (011), (111), (012) and (113), four different orientation relationships were found. In all cases at least one closest packed direction of the oxide was parallel to a closest packed direction of the metal. The shapes of the oxide growths and the particular faces present were determined. Only the three most densely packed faces occurred on the oxide.

548.5

13887. STUDY OF THE ORIENTED OVERGROWTH OF GERMANIUM ON A MONOCRYSTAL OF FLUORITE.
J.Marucchi and N.Nifontoff.
C.R. Acad. Sci. (Paris), Vol. 249, No. 3, 435-7 (July 20, 1959). In French.
It is shown that oriented overgrowth takes place when Ge is evaporated on to a (111) cleavage face of CaF_2. C.A.Hogarth

548.5

13888. GROWTH OF BISMUTH SINGLE CRYSTALS BY THE PULLING TECHNIQUE. E.M.Porbansky.
J. appl. Phys., Vol. 30, No. 9, 1455-6 (Sept., 1959).
Strain-free single crystals of controlled orientation were grown from melts of zone-refined bismuth and bismuth-tin mixtures (up to 1 at.% tin), at rates as high as 3 cm /hr and 1 cm /hr respectively, in a hydrogen atmosphere using vitreous silica or graphite crucibles. J.E.Caffyn

548.5

13889. MICROPYRAMIDS ON GERMANIUM FORMED DURING MICROALLOYING. R.Zuleeg.
J. appl. Phys., Vol. 30, No. 9, 1461-2 (Sept., 1959).
These structures are made visible by electrochemical etching with KOH for 3 sec at a d.c. current of 10 mA andare thought to be associated with the ends of edge dislocations generated by thermal stresses occuring during the forming process. J.E.Caffyn

548.5 : 539.19

13890. SPHERULITE CRYSTALLIZATION IN POLYPROPYLENE.
F.J.Padden, Jr and H.F.Keith.
J. appl. Phys., Vol. 30, No. 10, 1479-84 (Oct., 1959).
A survey was made of spherulites formed by the isothermal crystallization of polypropylene from the melt in the temperature range 110°-148° C. Four types of spherulite have been distinguished

and their structural morphology, optical properties, melting behaviour, and growth rates have been examined.

548.5

13891. SOLUTION GROWN CRYSTALS OF AN ACETAL RESIN.
P.H.Geil, Jr, N.K.J.Symons, and R.G.Scott.
J. appl. Phys., Vol. 30, No. 10, 1516-17 (Oct., 1959).

Single crystals of polyoxymethylene have been grown from dilute solution. They consist of hexagonal lamellae, often thickened by growth from screw dislocations. The chain molecules are normal to the lamellae which are 100 A thick. Thus, it is suggested that the molecules have a folded conformation. In many of the crystals double Bragg reflections were found in the electron diffraction patterns, resulting from rotation of the lamellae during the growth. Dark field electron microscope photographs of these crystals exhibit moiré patterns.

548.5 : 537.311.33

13892. CLEANING OF SILICON SURFACES BY HEATING IN HIGH VACUUM. F.G.Allen, J.Eisinger, H.D.Hagstrum and J.T.Law.
J. appl. Phys., Vol. 30, No. 10, 1563-71 (Oct., 1959).

Results from experiments with four independent surface-sensitive phenomena agree in demonstrating that an atomically clean surface can be produced on silicon single crystals by heating to 1550° K or above for several minutes in high vacuum. The four phenomena studied are: (1) oxidation and gas adsorption; (2) Auger neutralization of He^+ ions; (3) external photoelectric emission; (4) field electron emission in a Müller microscope. Evidence is given as to the nature of the silicon surface before cleaning, properties of the clean surface, and behaviour upon contamination with gases and during subsequent recleaning. The surfaces were found to form a permanent p-type layer several microns deep as a result of the vacuum heating.

548.5

13893. ETCH PITS IN LEAD CRYSTALS. Y.Hiki.
J. Phys. Soc. Japan, Vol. 13, No. 8, 970-1 (Aug., 1958).

Single-crystal lead, 99.99% pure, was chemically polished with CH_3COOH plus H_2O_2 (ratio 1 : 3) for 15-30 sec, then electrolytically etched in a 1% (weight) aqueous solution of sulphamic acid at 18° C for 45 sec at a current density of 0.2 A cm^{-2}. The etch-pit density increases up to 1.7×10^7 cm^{-2} on annealing the specimens in ethylene glycol at 150° C. This is interpreted in terms of the formation of Cottrell atmospheres. W.Bardsley

548.5

13894. ETCH PITS OF Sb SINGLE CRYSTALS.
J.Shigeta and M.Hiramatsu.
J. Phys. Soc. Japan, Vol. 13, No. 11, 1404 (Nov., 1958).

The cleavage faces were etched in 10 g $FeCl_3$, 30 ml HCl and 120 ml H_2O, at temperatures of 25°-45° C, and for from one to several minutes, to give etch pits with densities ranging from $1\text{-}20 \times 10^6$ cm^{-2}. The pits are identified with dislocations. Thermal etch pits produced by heating at 400° C in a vacuum of 10^{-3} to 10^{-4} mm Hg for several minutes show a qualitative similarity to the chemical etch pits, but as the density of the thermal pits is far lower than that of the chemical pits it is concluded that the thermal etch technique is not satisfactory for revealing dislocations in such crystals. W.Bardsley

548.5

13895. EXPERIMENTAL AND THEORETICAL STUDY OF KINETICS OF BULK CRYSTALLIZATION IN POLY(CHLOROTRIFLUOROETHYLENE).
J.D.Hoffman, J.J.Weeks and W.M.Murphey.
J. Res. Nat. Bur. Stand, Vol. 63A, No. 1, 67-98 (July-Aug., 1959).

The rate of isothermal bulk crystallization of poly(chlorotrifluoroethylene), T_m = 221° C, was measured from 170° to 200° C. The intrinsic bulk crystallization, which accurately followed an n = 2 law, was shown to be a result of the injection of primary nuclei sporadically in time, with one-dimensional growth of centres derived from these nuclei. The crystallites are exceedingly small. The one-dimensional growth process was isolated by nucleating specimens with seed crystals, and its temperature-dependence determined between 191° and 205° C. The seed crystal isotherms followed an n = 1 law. The temperature coefficients of the rate of nucleation and the rate of growth were both strongly negative. A theory of homogeneous nucleation that takes into account the segmental character of the polymer chains is developed in some detail. A cylindrical nucleus is assumed. In the temperature range near the melting point, region A, where the radius and length of the nucleus are unrestricted, the rate of nucleation is shown to be proportional to $\exp(-\alpha/T^3\Delta T^2)$. The nucleation rate is proportional to $\exp(-\beta/T^2\Delta T)$ in region B, which extends from somewhat below the melting point to considerably lower temperatures; the length of the nucleus has a constant value l_0 in this region, but the radius is unrestricted. (In the above expressions, α and β are constants). Finally, at sufficiently low temperatures, region C is entered. Under certain circumstances, the rate of nucleation in region C will be extremely rapid, and correspond to the "nucleative collapse" of the supercooled liquid state. A calculation of the one-dimensional growth rate shows that it is proportional to $\exp(-\gamma/T^2\Delta T)$ where $\beta = \gamma$. A careful analysis of the experimental data obtained between 170° and 200° C clearly showed that both the rate of nucleation and the rate of growth were proportional to $\exp(-\beta/T^2\Delta T)$ and not $\exp(-\alpha/T^3\Delta T^2)$. The primary nucleation event was thus of type B in this interval. A detailed analysis of the data is given, and surface free energies and the dimensions of the nuclei quoted. Quenching experiments, where the polymer was crystallized well below 170° C, gave a firm indication of the existence of region C. An experimental study was made of the extremely slow crystallization process that prevailed when the degree of the crystallinity became high. The onset of this stage of the crystallization was interpreted as being the result of massive degree of impingement. This interpretation is justified by the calculations of Lauritzen, who has given a theory of impingements that predicts a pseudoequilibrium degree of crystallinity. As indicated above, the growth process originating at homogeneous nuclei is not of a three-dimensional or spherulitic character in the region of study. Such stray spherulites as do appear in this region are shown to originate at heterogeneities. The possibility that the intrinsic growth process may become three-dimensional at crystallization temperatures sufficiently near T_m is discussed.

548.5 : 537.311.33

13896. A RELIABLE METHOD FOR THE PRODUCTION OF HIGH PURITY INDIUM ANTIMONIDE. K.F.Hulme.
J. Electronics and Control, Vol. 6, No. 5, 397-402 (May, 1959).

Principles described previously (See Abstr. 8968 of 1957) were applied to the production of the semiconducting compound InSb, conveniently and reliably, with uncompensated donor densities of about $10^{14}/cm^3$. Details of the apparatus and method are given, and the factors limiting the purity to this level are considered.

548.5

13897. ADSORPTION OF FOREIGN IMPURITIES AND THE MECHANISM OF CRYSTAL GROWTH. G.M.Bliznakov.
Kristallografiya, Vol. 4, No. 2, 150-6 (March-April, 1959).
In Russian.

Theories of crystal growth are reviewed and it is concluded that in the absence of secondary effects, foreign impurities lower the growth velocity. Experiments supporting the conclusion are reported for the growth of (100) and (111) faces of $NaClO_3$ in the presence of varying amounts of Na_2SO_4, and of the (100) face of KBr in the presence of varying amounts of phenol. The amount of phenol in the crystals is very small, suggesting that the action of the impurity is primarily a surface effect. Results for the growth of $Pb(NO_3)_2$ in the presence of methylene blue are, however, anomalous, since the growth velocity passes through a maximum on increasing the methylene blue concentration. R.F.S.Hearmon

548.5

13898. THE QUESTION OF THE HEALING OF CRACKS IN ICE
M.O.Kliya.
Kristallografiya, Vol. 4, No. 2, 263-5 (March-April, 1959).
In Russian.

Cracks were produced in specially prepared ice plates by a blow from a needle point, and the healing process from the vapour observed through a microscope at various temperatures. Between −5° and −8° C the healing took 5–8 hr; it was photographed cinematically, and a descriptive account of the process is given.
R.F.S.Hearmon

548.5

13899. AN UNUSUAL HABIT OF CRYSTALS.
E.Brüche and J.Demny.
Naturwissenschaften, Vol. 46, No. 7, 225 (1959). In German.

It was found that Au crystals, deposited from AuCl solution, exhibited an unusual habit when examined in the electron microscope. Thin hexagonal plates were observed, some of which showed moiré fringes. Examination showed, however, that the latter type did not arise from a mismatch between overlapping crystals, but were associated with the spiral growth of a single crystal.
J.Thewlis

548.5

00. THE INITIAL STAGES OF GROWTH OF ORIENTED COPPER CLEI ON SINGLE CRYSTAL SURFACES OF SILVER.
Grunbaum, R.C.Newman and D.W.Pashley.
l. Mag. (Eighth Ser.), Vol. 3, 1337-41 (Dec., 1958).

Layers of metallic copper of less than 1 A in average thickness re deposited in a controlled manner on to smooth (111) surfaces silver inside an electron diffraction camera. It was found that electron diffraction pattern from oriented copper nuclei appeared denly at some critical thickness. This critical thickness de- ases with increasing substrate temperature, being about 0.9 A at om temperature and 0.2 A at 300°C. Possibilities for the initial ucture of the deposit, and for the change which occurs at the tical thickness, are considered, and the effect of substrate nperature is discussed.

548.5

901. GOLD CRYSTAL LAMELLAE AS SPIRAL SURFACES.
Brüche and J.Demny.
Naturforsch., Vol. 14a, No. 4, 351-4 (April, 1959). In German.

Chemically deposited lamellae, 100 A thick and several microns extent, grow in the form of spiral staircases. These "staircase ystals" exhibit moiré patterns under the electron microscope, d are quite different from the more familiar spiral growths ntred on screw dislocations. B.T.M.Willis

548.5 : 537.226.2

PRODUCTION AND TWINNING OF TRIGLYCINE SULPHATE RYSTALS. See Abstr. 13257

548.5 : 539.2

EFFECT OF SUBSTRATE CRYSTALLINE PERFECTION ON PITAXIAL GROWTH. See Abstr. 13778

548.5 : 539.374

PROPERTIES OF DEFORMED ROCK SALT CRYSTALS. e Abstr. 13855

X-RAY CRYSTALLOGRAPHY

548.73/.74

X-RAY AND ELECTRON INVESTIGATION OF MATERIALS. ee also the Section entitled "STRUCTURE OF SOLIDS".

548.732

3902. A STUDY OF PENDELLÖSUNG FRINGES IN X-RAY IFFRACTION. N.Kato and A.R.Lang.
cta cryst., Vol. 12, Pt 10, 787-94 (Oct., 1959).

X-ray topographs of a new type have revealed fine fringes in the ffraction images of wedge-shaped parts of perfect and nearly per- ct crystals. The fringes are analogous to those seen in electron icroscope images of wedge-shaped parts of magnesium oxide crys- ls and can be interpreted according to the theory applicable to the ectron case. Fringe spacing depends upon X-ray wavelength, edge-angle, inclination of reflecting plane to the wedge surfaces, d the structure amplitude of the reflection. Discovery of these inges shows that (a) parts of real crystals behave as ideally perfect om the X-ray diffraction standpoint; (b) the dynamical theory of ffraction may be applied quantitatively under practical experiment- conditions, and (c) structure amplitudes of low-order reflections ay be determined by fringe-spacing measurements, without any eed for measuring reflection intensities. Tests of the theory on repared wedges of silicon and quartz indicate a slight systematic screpancy of 4 to 5% between calculated and observed values of ructure amplitude, and suggest also that Wei's (1935) F-values for uartz $10\bar{1}1$ and $\bar{1}\bar{1}22$ are too low by 9% and 4% respectively. Ex- eriments suggest that to explain fully the observations some modi- cation of the dynamical theory is required in the direction of allow- g for a spherical wavefront of the incident beam.

548.732

3903. X-RAY DIFFRACTION FROM MICROCRYSTALLINE ANDOM LAYER STRUCTURES. J.R.Townsend.
cta cryst., Vol. 12, Pt 10, 806-11 (Oct., 1959).

A theoretical study is given of the X-ray scattering from a wder composed of circular planes of atoms. When the planes are rouped into parallel layers, the effects resulting from the tangent plane approximation (TPA) are determined for the basal (00l) reflections and the role of rotational and displacement disorder are determined for both 00l and hk0 reflections. When applied to the 002 peaks from partially graphitized carbons, it is found that the use of the TPA predicts a value of the interlayer spacing which is at worst 2% too small. Analytical expressions for the small angle scattering follow as a special case of the 00l reflections. As expected, the 00l maxima are appreciably altered when plane displacements become comparable with plane radii, while the shape of hk0 maxima are essentially determined by the rotational disorder alone.

548.732

13904. INTERPRETATION OF DIFFRACTOMETER LINE PROFILES. J.Ladell, W. Parrish and J.Taylor.
Acta cryst., Vol. 12, Pt 8, 561-7 (Aug., 1959).

A truncation procedure [Ladell, Parrish and Taylor, Acta cryst., Vol. 12, Pt 3, 253 (March, 1959)] has been proposed to circumvent certain practical and theoretical difficulties in the calculation of the moments of diffraction line profiles. The theory of analysis of line profiles by the method of moments is reviewed. A rigorous formulation of the truncation procedure is given and the truncation error is estimated. An analytic representation of the spectral profile of Kα doublets is derived so that the spectral characteristics needed for the analysis of line profiles can be obtained.

548.732

13905. DISPERSION, LORENTZ AND POLARIZATION EFFECTS IN THE CENTROID METHOD OF PRECISION LATTICE PARAMETER DETERMINATION.
J.Ladell, M.Mack, W.Parrish and J.Taylor.
Acta cryst., Vol. 12, Pt 8, 567-70 (Aug., 1959).

It has been found that in the determination of lattice parameters by the method of moments, corrections must be applied to account for the distortion of line profiles caused by the effects of dispersion, Lorentz and polarization factors. These corrections have been calculated as a function of the diffraction angle for Cu, Kα, Fe Kα and Cr Kα radiations. The corrections presented here are compared with those given by Pike.

548.732

13906. CONTRIBUTION OF TEMPERATURE DIFFUSE SCATTERING TO WINGS ON BRAGG PEAKS.
D.R.Chipman and A.Paskin.
J. appl. Phys., Vol. 29, No. 11, 1608 (Nov., 1958).

The observed shape of the X-ray thermal diffuse scattering curves in the neighbourhood of Bragg peaks is found to be accounted for, within experimental error, when allowance is made for the difference in velocity between longitudinal and transverse elastic waves. J.Thewlis

548.733

13907. A SYNCHRONOUS MODULATION AND DEMODULATION PROCEDURE APPLIED TO X-RAY TECHNIQUES. L.Godefroy.
C.R. Acad. Sci. (Paris), Vol. 248, No. 11, 1686-8 (March 16, 1959). In French.

A barium titanate crystal was placed in an alternating electric field; a beam of X-rays was diffracted into a Geiger counter whose output was switched alternately, and synchronously with the electric field, into two scalers. Significant differences between the number of counts were obtained. A.R.Stokes

548.733

13908. HIGH-TEMPERATURE X-RAY CAMERA RKVT-1200.
V.V.Zubenko, S.S.Kvitka and M.M.Umanskii.
Kristallografiya, Vol. 4, No. 2, 244-7 (March-April, 1959). In Russian.

The camera is of ceramic construction and possesses the following features: (1) it can be used for polycrystalline materials up to 1200°C; (2) the diffraction lines can be recorded between angles of 6° and 84° on semicylindrical film; (3) it can be evacuated. Drawings are given of the camera itself and of the rotating and and centring mechanism. To illustrate its use, the parameter a of CeB_6 was measured as a function of temperature between 100° and 1200°C. R.F.S.Hearmon

548.734.3

13909. DIFFUSE X-RAY SCATTERING IN POWDER PATTERNS ARISING FROM STATIC DISPLACEMENTS IN CUBIC SOLID SOLUTIONS. C.R.Houska and B.L.Averbach.
J. appl. Phys., Vol. 30, No. 10, 1532-4 (Oct., 1959).

The diffuse scattering arising from static atomic displacements

from the average lattice sites has been evaluated for cubic powder patterns. This excess scattering results from elastic interactions between atoms of different size in binary solid solutions, and is compatible with the conservative intensity loss of the main reflections. The resultant scattering was found to take the form

$$I_S = \bar{f}^2 H(x)\{1-\exp[-2M'(x)]\},$$

where H(x) is a weak modulation which varies by approximately 10% about unity.

548.734.3

13910. USE OF SYNTHETIC QUARTZ CRYSTALS AS A SUPPORT FOR SPECIMENS IN POWDER PHOTOGRAPHS.
H.Hagihara, S.Yamashita and A.Takeda.
Nature (London), Vol. 183, 1666-7 (June 13, 1959).

Thin needle-shaped crystals obtained during experiments on hydrothermal growth of quartz crystals were found useful as supports for powder specimens in X-ray Debye—Scherrer technique. Sharp reflections from quartz help in locating the equatorial line on the photograph, the detection of "impurity" radiation from the X-ray tube, and can be used for film calibration. J.Adam

548.734.3

13911. A DEVICE FOR INDEXING X-RAY POWDER PHOTOGRAPHS FROM MONOCLINIC MATERIALS. S.L.Nudel'man.
Pribory i Tekh. Eksper., 1959, No. 3, 125-7 (May-June).
In Russian.

A device already described by the author (Pribory i Tekh. Eksper., 1957, No. 2, 83) for indexing orthorhombic powder photographs is extended to the monoclinic case. For a monoclinic pattern the hOO, OkO, OOl, hkO and Okl reflections can be indexed as if they belonged to an orthorhomic crystal. A system of rods forming a rhombus of dimensions related to those of the unit cell moves over a diagram containing lines derived from the X-ray pattern. The method is illustrated for the case of the mineral dickite. A.L.Mackay

548.735

13912. THE EFFECT OF SEGREGATION ON THE DIFFRACTION FROM A FACE-CENTRED CUBIC ALLOY WITH DEFORMATION FAULTS. B.T.M.Willis.
Acta cryst., Vol. 12, Pt 9, 683-9 (Sept., 1959).

The Paterson theory (Abstr. 7684 of 1952) of X-ray scattering from a face-centred cubic structure with deformation faults is extended to include the case of a f.c.c. alloy, in which segregation of the alloy components takes place at the faults. The principal effect of segregation is to make the reflections asymmetrical. It is possible that this asymmetry could be detected in the powder lines of certain cold-worked alloys.

548.735

13913. SOME RELATIONS BETWEEN CRYSTAL STRUCTURES. V. INTERACTION OF TWO POSITIONAL CORRELATIONS OF ELECTRONS IN THE CASE OF BRASS-LIKE ALLOY PHASES. K.Schubert.
Z. Naturforsch., Vol. 14a, No. 7, 650-8 (July, 1959). In German.

For Pt IV see Abstr. 7620 (1959). Several features of the face-centred cubic structure (e.g. variations from the stacking sequence ABCABC...) are explained assuming a positional correlation between the valence electrons. An argument follows for the occurrence of close-packed hexagonal structures at a valence electron concentration greater than 1.4 and for the dependence of the axial ratio c/a on this concentration. Various features of the body-centred cubic structure are interpreted in a similar way. B.T.M.Willis

548.735.2

13914. A UNIFIED PROGRAM FOR PHASE DETERMINATION, TYPE $2P_1$. J.Karle and H.Hauptman.
Acta cryst., Vol. 12, Pt 8, 590-3 (Aug., 1959).

For previous work, see Abstr. 10364 (1959). The unified programme for phase determination is valid for all the space groups and both the equal and unequal atom cases. The present paper is concerned with the centrosymmetric space groups comprising type $2P_1$. A detailed procedure for phase determination is described.

548.735.4

13915. A UNIFIED PROGRAM FOR PHASE DETERMINATION, TYPE $3P_1$. H.Hauptman and J.Karle.
Acta cryst., Vol. 12, Pt 10, 802-5 (Oct., 1959).

The unified programme for phase determination, valid for all the space groups and both the equal and unequal atom cases (see Abstr. 10364 of 1959), is continued here. The present paper (fourth in the series) is concerned with the centrosymmetric space groups comprising type $3P_1$. A detailed procedure for phase determination is described for this type.

548.735.

13916. ALGEBRA OF STRUCTURE FACTORS. V. E.F.Bertaut.
Acta cryst., Vol. 12, Pt 8, 570-4 (Aug., 1959).

For Pt IV, see Abstr. 9024 (1959). The possibility of writing the structure invariant $|E(H_1)E(H_2)E(H_3)|\cos\alpha$ as a function of absolute values of structure factors is investigated in each space group. Hauptman and Karle's affirmative result (Abstr. 7621-2 of 1959) for P1 may be extended to non-centrosymmetric space groups of order 2. In the present status of structure factor algebra it is not possible to generalize this result to further space groups.

548.735.4 : 51

13917. TO FIT A PLANE OR A LINE TO A SET OF POINTS BY LEAST SQUARES. V.Schomaker, J.Waser, R.E.Marsh and G.Bergman.
Acta cryst., Vol. 12, Pt 8, 600-4 (Aug., 1959).

In the description of a crystal structure, it is sometimes desired to fit a least-squares plane to the positions found for some approximately coplanar set of atoms. The problem of the plane is essentially equivalent to the problem of finding the principal plane of least inertia for a set of point masses, and the problem of the best line is similarly equivalent to the very closely related problem of the least axis of inertia. The discussion therefore covers line as well as plane. A convenient numerical solution is given.

548.735.

13918. THE DETERMINATION OF ACCURATE HEAVY-ATOM PARAMETERS IN ISOMORPHOUS ACENTRIC CRYSTALS. W.Hoppe
Acta cryst., Vol. 12, Pt 9, 665-74 (Sept., 1959). In German.

There are two possibilities for the determination of coordinates using all measured intensities: (1) Correlation functions. The correlation functions are modulated by the structure of the crystal, thus disturbing the determination of the heavy atom coordinates. The influence of the crystal structure is discussed using convolution principles for the following correlation functions constructed with the observed structure factors F of the protein, F_1 of its heavy atom derivative, and f_1 of the heavy atoms only:

C-function (coefficients $\Delta_1\Delta_2$; $\Delta_1 = \{|F_1|^2-|F|^2\}$),
C'-function (coefficients A_1A_2; $A_1 = \{|F_1|^2-|F|^2-f_1^2\}/2f_1$),
C''-function (coefficients $\varphi_1\varphi_2$; $\varphi_1 = A_1/|F|$),
C'''-function (coefficients W_1W_2; $W_1 = \{|F_1|^2-|F|^2-f_1^2\}$.

It is shown that pseudocentres of symmetry particularly disturb the determination. The calculation of the composing convolution structures in a special case (myoglobin) suggests that the structure of protein crystals is quite suitable for the use of correlation functions. An error theory, based on the Gaussian error distribution law, is given. Examples of the correlation functions (in the case of myoglobin) have been calculated. (2) In the special case of one heavy atom in the asymmetric unit a determination of the heavy atom parameters with a simultaneous elimination of the influence of the crystal structure is in principle possible. In case preliminary coordinates of the heavy atom parameters and of the phases of the acentric crystal have been determined, modified refinement methods are possible, namely difference Fourier synthesis and least-squares refinement of the heavy atom parameters.

548.735.

13919. A GENERAL LEAST-SQUARES PROGRAM FOR THE REFINEMENT OF ANISOTROPIC THERMAL PARAMETERS. W.M.Macintyre.
Acta cryst., Vol. 12, Pt 10, 761-4 (Oct., 1959).

A programme is described for the refinement of anisotropic thermal parameters and atomic coordinates on the IBM 704 computer. The programme covers all space groups of the triclinic, monoclinic, orthorhombic and tetragonal systems. A set of general structure factor expressions has been derived, one expression covering all space groups in a single system. A modified diagonal approximation is used.

548.735.

13920. A DIRECT SIGN-DETERMINING METHOD BASED UPON FOURIER SERIES. A.Bezjak.

A a cryst., Vol. 12, Pt 10, 765-70 (Oct., 1959).
New functions G(H, ξ) and K(H, ξ) derived by application of Fourier series with the coefficients depending upon unitary structure factors U(H) are introduced and a method for their use for sign determination is suggested. For all ξ within the interval $\xi_{min} < \xi < \frac{1}{2}$, where ξ_{min} is a structure dependent parameter, the conditions G(H, ξ) ≥ 0 and K(H, ξ) = 0 are satisfied only then when all correct signs are allotted to the coefficients. The method was successfully applied to a hypothetical centrosymmetric structure for which the signs of U(h00) for all h from 1 to 16 were determined. A generalization of the functions which enables to include gradually also |U(hkl)| into the computation is also suggested.

548.735.4

1921. ACCURACY OF BOND DISTANCES IN OBLIQUE COORDINATE SYSTEMS. D.H.Templeton.
A a cryst., Vol. 12, Pt 10, 771-3 (Oct., 1959).
If σ(x) is the standard deviation of an atomic coordinate, the standard deviation of position of that atom in the direction of the corresponding reciprocal axis is aσ(x) cos aa*, where aa* is the angle between the direct and reciprocal axes. When this standard deviation is independent of direction, the statistical correlation coefficient of two coordinates of the atom is given by the cosine of the angle between the corresponding reciprocal axes. In the method of least squares, if the standard deviation of a coordinate is calculated with neglect of cross terms, it tends to be low by the factor cos aa*. It is shown that crystallographic independence does not imply statistical independence.

548.735.4

1922. THE TREATMENT OF ERRORS IN THE ISOMORPHOUS REPLACEMENT METHOD. D.M.Blow and F.H.C.Crick.
Acta cryst., Vol. 12, Pt. 10, 794-802 (Oct., 1959).
This treatment is intended for complex structures where conventional refinement is impossible. A method is described for assessing the errors which arise in applying the isomorphous replacement method. Both errors due to non-isomorphism and observational errors are considered. Probability functions are derived which given, in the centrosymmetric case, the probabilities of different phases. These probabilities may be used to calculate a "best" Fourier, in which the errors in electron density are minimized, and also to estimate the r.m.s. error in this "best" Fourier.

548.736.1 : 537.531

ATOMIC SCATTERING FACTOR FOR ALUMINIUM. See Abstr. 13358

548.736.3

1923. CRYSTAL STRUCTURE STUDIED ON TRITITANIUM PENTOXIDE, Ti_3O_5. S.Åsbrink and A.Magnéli.
Acta cryst., Vol. 12, Pt 8, 575-81 (Aug., 1959).
Trititanium pentoxide is dimorphic — a rapid, reversible phase transformation occurring at about 120°C. The high-temperature modification is of the anosovite type (slightly deformed pseudobrookite structure). It can be stabilized at room temperature by small contents of iron. The crystal structure of the low-temperature form has been determined. It is monoclinic, space group C2/m, with a cell content of 4 Ti_3O_5 and the unit-cell dimensions. a = 9 752, b = 3.802, c = 9.442 A; β = 91.55°. It may be described in terms of TiO_6 octahedra which are joined by sharing edges and corners to form an infinite three-dimensional framework. The structure is discussed and compared with the anosovite structure.

548.736.3

1924. LAVES PHASE COMPOUNDS OF RARE EARTHS AND OF HAFNIUM WITH NOBLE METALS. V.B.Compton and B.T.Matthias.
Acta cryst., Vol. 12, Pt 9, 651-4 (Sept., 1959).
The compounds $ScIr_2$, YAl_2, YRh_2, YIr_2, YPt_2, $LaRu_2$, $LaRh_2$, $LaOs_2$, $LaIr_2$, $LaPt_2$, $CeRu_2$, $CeRh_2$, $CeOs_2$, $CeIr_2$, $PrRu_2$, $PrRh_2$, $PrOs_2$, $PrIr_2$, $PrPt_2$, $NdRu_2$, $NdRh_2$, $NdIr_2$, $NdPt_2$, $GdRh_2$, $GdIr_2$, and $GdPt_2$ are cubic Laves phases, $MgCu_2$ structure (C15). The space group is O_h^7—Fd3m with 8 formula weights in the unit cell. Lattice constants for these compounds are reported. The compounds $HfRe_2$, $HfOs_2$, $ScRu_2$, $ScOs_2$, YRu_2, YRe_2, YOs_2, $PrOs_2$, $NdOs_2$, $SmOs_2$, $GdRu_2$, $GdOs_2$, $ErRu_2$, $LuRu_2$, and $LuOs_2$ are hexagonal Laves phases, $MgZn_2$ structure (C14). The space group is D_{6h}^4—$P6_3/mmc$ with 4 formula weights in the unit cell. Lattice constants are reported. Both the cubic and hexagonal Laves phases were determined by the powder diffraction method. The superconducting transition temperatures for $ScRu_2$, $ScOs_2$, $ScIr_2$, YRu_2, YRe_2, YOs_2, YIr_2, YPt_2, $LaRu_2$, $LaOs_2$, $CeRu_2$, $LuOs_2$, $HfRe_2$ and $HfOs_2$ are reported. Ferromagnetic transition temperatures are given for the praseodynium, neodymium and gadolinium compounds and for $SmOs_2$.

548.736.3

13925. THE CRYSTAL STRUCTURE OF UPt_2.
B.A.Hatt and G.I.Williams.
Acta cryst., Vol. 12, Pt 9, 655-7 (Sept., 1959).
The structure is orthorhombic, space group Ama2 with a = 5.60, b = 9.68, c = 4.12 A. The similarity between this structure and UPt_3 is shown.

548.736.3

13926. THE CRYSTAL STRUCTURE OF $ZrAl_2$. C.G.Wilson.
Acta cryst., Vol. 12, Pt 9, 660-2 (Sept., 1959).
The structure was determined from powder samples and imperfect single crystals. The unit cell is hexagonal with a = 5.282, c = 8.748 A; c/a = 1.656. There are four $ZrAl_2$ units per cell. The calculated density is 4.56 g cm^{-3}. The space group is $P6_3/mmc$. The structure is a Laves phase of the C_{14}, $MgZn_2$ type. The contraction of the Al substructure and the expansion of the Zr substructure support the general conclusions about the constitution of Laves phases.

548.736.3

13927. TRANSITION ELEMENT—RARE EARTH COMPOUNDS WITH THE Cu_5Ca STRUCTURE. J.H.Wernick and S.Geller.
Acta cryst., Vol. 12, Pt 9, 662-5 (Sept., 1959).
A number of new B_5A compounds, with A a rare earth or yttrium and B a transition element, Co, Ni, or Cu, having the Cu_5Ca structure, were prepared. In most of the compounds, the interatomic distances are normal. However, Ce appears to have a valence substantially greater than three. Also, in Co_5Pr, Pr appears to have a valence slightly greater than three.

548.736.3 : 537.311.31

SUPERSTRUCTURE OF $CuAu_3$. See Abstr. 13273

548.736.3

13928. THE CRYSTAL STRUCTURES OF $PuNi_3$ AND $CeNi_3$.
D.T.Cromer and C.E.Olsen.
Acta cryst., Vol. 12, Pt 9, 689-94 (Sept., 1959).
The structure of $PuNi_3$ and the structure and composition of $CeNi_3$ were determined by single crystal X-ray methods. $PuNi_3$ has three formula units in a rhombohedral unit cell with a = 6.22 A and α = 33° 44', probable space group R3m. $CeNi_3$ has six formula units in a hexagonal cell with a = 4.98 and c = 16.54 A, probable space group $P6_3/mmc$. These structures are both derived from stacking single layers of the MNi_5 structure ($CaCu_5$-type) and double layers of the MNi_2 structure (Cu_2Mg-type).

548.736.3

13929. THE CRYSTAL STRUCTURE OF Nb_2Be_{17}.
A.Zalkin, D.E.Sands and O.H.Krikorian.
Acta cryst., Vol. 12, Pt 10, 713-15 (Oct., 1959).
Nb_2Be_{17} is rhombohedral with a = 5.599 A, α = 82.84°. The dimensions of the triply primitive hexagonal cell are a = 7.409, c = 10.84 A. The space group is $R\bar{3}m$, and there is one Nb_2Be_{17} unit in the rhombohedral cell. Each Nb atoms has 19 Be neighbours at 2.57 to 2.85 A (2.72 A average). There are four types of Be atom: Be_I has 1 Nb neighbour at 2.57 and 13 Be at 2.23 to 2.47 A; Be_{II} has 2 Nb at 2.85 and 10 Be at 2.13 to 2.25 A; Be_{III} has 2 Nb at 2.62 and 10 Be at 2.13 to 2.47 A; Be_{IV} has 3 Nb at 2.68, 2.76, and 2.84 A and 9 Be at 2.10 to 2.31 A.

548.736.3

13930. THE CRYSTAL STRUCTURE OF $MoCl_5$.
D.E.Sands and A.Zalkin.
Acta cryst., Vol. 12, Pt 10, 723-6 (Oct., 1959).
$MoCl_5$ has the $NbCl_5$ type structure. The crystal system is monoclinic with a = 17.31, b = 17.81, c = 6.079 A, β = 95.7°. The space group is C2/m, and there are 12 $MoCl_5$ units in the unit cell. The structure consists of dimers (Mo_2Cl_{10}) with the chlorine atoms forming two octahedra which share a common edge. The molybdenum atoms occupy the centres of the octahedra and are joined by two chlorine bridge bonds. The Mo—Cl bridge bond length is 2.53 A; the Mo—Cl non-bridge bond length is 2.24 A.

548.736.3

13931. THE VARIATION OF SUPERSTRUCTURE IN IRON SELENIDE Fe_7Se_8. A.Okazaki.
J. Phys. Soc. Japan, Vol. 14, No. 1, 112-13 (Jan., 1959).

Using X-ray diffraction methods, the author observed a triclinic superlattice which differs from the previously observed hexagonal form in the stacking sequence of the AB-planes. The transition into the hexagonal form takes place at 250°-300° C. In the range 320-450° C, there is evidence of a third partially ordered superlattice. M.G.Priestley

548.736.3

13932. CRYSTAL STRUCTURE OF COMPOUNDS OF URANIUM AND GERMANIUM. E.S.Makarov and V.N.Bȳkov.
Kristallografiya, Vol. 4, No. 2, 183-5 (March-April, 1959).
In Russian.

An X-ray investigation is reported of the symmetry and cell dimensions of the compounds U_5Ge_3 (hexagonal); U_3Ge_4 and UGe_2 (both orthorhombic); and UGe_3 (cubic). For U_5Ge_3 and UGe_2, the space groups are C6/mcm and Cmcm respectively. R.F.S.Hearmon

548.736.4

13933. THE CRYSTAL STRUCTURE OF CESIUM TETRABROMOZINCATE, Cs_2ZnBr_4. B.Morosin and E.C.Lingafelter.
Acta. cryst., Vol. 12, Pt 10, 744-5 (Oct., 1959).

The crystal structure was determined by three-dimensional Fourier (difference) methods. The structure is essentially the same as that of Cs_2ZnCl_4, with 4 molecules in a cell of dimensions $a_0 = 10.196$, $b_0 = 7.770$, $c_0 = 13.517$ A, space group Pnma. The $ZnBr_4^{-2}$ tetrahedron is appreciably distorted by the steric "pressure" of one neighbouring Cs^+ ion.

548.736.5

13934. BASIC BERYLLIUM ACETATE. I. THE COLLECTION OF INTENSITY DATA. A.Tulinsky, C.R.Worthington and E.Pignataro.
Acta cryst., Vol. 12, Pt 9, 623-6 (Sept., 1959).

Two independent, three-dimensional sets of intensity data have been collected from two different crystals of basic beryllium acetate $[Be_4O(CH_3CO_2)_6$, cubic, Fd3, $a_0 = 15.74$ A, Z = 8]. An Eulerian cradle Geiger counter spectrometer was employed for the measurements. Two crystals were surveyed so as to insure against systematic errors in the data. The integrated intensities of the two sets of data were obtained in different ways, one by stationary crystal-stationary counter and the other by moving crystal-moving counter. Each set of data is affected by a different kind of statistical counting error (constant count, fixed time count). The intensities of seven strong low order reflections that are affected by extinction in the data crystals have been determined from the considerations of two additional smaller crystals and a powder. The reproducibility of equivalent reflections has been tested in two different ways and has been found to be about 4% in intensity. A detailed comparison of the two sets of data has been carried out. The overall agreement, all reflections included, is of the order of 8% in intensity.

548.736.5

13935. BASIC BERYLLIUM ACETATE. II. THE STRUCTURE ANALYSIS. A.Tulinsky and C.R.Worthington.
Acta cryst., Vol. 12, Pt 9, 626-34 (Sept., 1959).

Three-dimensional Fourier methods and two sets of independent intensity data were used. The observed structure was approximated through positional parameters, individual and general harmonic thermal vibrations and electron count parameters. The last two were fixed from difference density considerations in non-bonding directions. The final calculated structure agrees well with the observed structures except in certain regions of the acetate groups: there are effects present in the C—C and C—O bonds which suggest chemical bonding and/or anharmonic thermal vibrations; the acetate groups appear to possess a rigid body type angular oscillation about their C—C bonds. Half-weight hydrogen atoms of orientationally disordered methyl groups (two equally probable equilibrium orientations) have been located.

548.736.5

13936. BASIC BERYLLIUM ACETATE. III. EVIDENCE FOR CHEMICAL BONDING; ASSESSMENT OF ACCURACY. A.Tulinsky.
Acta cryst., Vol. 12, Pt 9, 634-7 (Sept., 1959).

Anharmonic thermal vibrations, systematic errors in the data and the systematic accumulation of random errors have been considered as possible sources for the excess positive density observed in the C—C and C—O bonds of the acetate group (Pt II). None were found to account for this density completely and satisfactorily. An assessment of the accuracy of the structure determination has been made by averaging over the cell. The advantage of atoms in special positions are discussed.

548.736

13937. THE CRYSTAL STRUCTURE OF $SeOCl_2 \cdot 2C_5H_5N$.
I.Lindqvist and G.Nahringbauer.
Acta cryst., Vol. 12, Pt 9, 638-42 (Sept., 1959).

The crystal structure of this addition compound was determin and refined using three-dimensional X-ray data. There are two molecules in the triclinic unit cell with the constants a = 8.19, b = 11.72, c = 10.82 A, all ±0.05 A, and $\alpha = 135.6 \pm 0.8°$, $\beta = 110.8 \pm 0.6°$ and $\gamma = 90.5 \pm 0.6°$. The space group is $P\bar{1}$. The crystal consists of molecules in which the coordination polyhedron around the central selenium atom is a tetragonal pyramid. The two chlor atoms and the two nitrogen atoms of the pyridine rings are bonded in the basal plane with atoms of the same kind in trans positions. The oxygen atom occupies the apex of the pyramid. The relevant bond distances and bond angles are: Se—Cl_1 = 2.57 ± 0.15, Se—Cl_2 = 2.39 ± 0.15, Se—N_1 = 2.19 ± 0.02, Se—N_2 = 2.20 ± 0.02, and Se—O = 1.59 ± 0.02 A, and Cl_1—Se—Cl_2 = 165.2 ± 0.2, N_1—Se—N_2 = = 173.8 ± 0.7, O—Se—Cl_1 = 95.1 ± 0.7, O—Se—Cl_2 = 99.7 ± 0.7, O—Se—N_1 = 90.9 ± 1.0, and O—Se—N_2 = 92.3 ± 1.0°. The molecule show a certain tendency to secondary dimerization over weak chlorine bridges. The bridging chlorine atom completes the distorted octahedron around the central selenium at a distance of 3.6 The nature of the chemical bonds and the problem of chloride-ion transfer processes in solutions of pyridine in selenium oxychlorid are briefly discussed.

548.736

13938. THE CRYSTAL STRUCTURE OF $SbCl_3 \cdot POCl_3$.
I.Lindqvist and C.I.Brändén.
Acta cryst., Vol. 12, Pt 9, 642-5 (Sept., 1959).

The crystal structure was determined from three-dimensional X-ray data. This is the first structure determination of an addition co pound with an oxychloride functioning as donor molecule. The structu built up of discrete $SbCl_3 \cdot POCl_3$ molecules. The coordination aro Sb is octahedral with an O atom from $POCl_3$ in the sixth corner. T approximately tetrahedral structure of $POCl_3$ is preserved. The b angle Sb—O—P is 143.7°. The structure is briefly discussed.

548.736

13939. THE CRYSTAL STRUCTURE OF BETECHTINITE, $Pb_2(Cu,Fe)_{21}S_{15}$. K.Dornberger-Schiff and E.Höhne.
Acta cryst., Vol. 12, Pt 9, 646-51 (Sept., 1959). In German.

The crystal structure of the mineral betechtinite was determi by Patterson and Fourier methods. The space group is Immm wit 2 formula units in a unit cell of dimensions a = 3.86, b = 14.67, c = 22.80 A. The Pb atoms are surrounded by 6 S atoms occupyin the corners of a straight prism with lead in its centre. Some of t Cu atoms have tetrahedral coordination of S, other Cu atoms lie in the centre of a triangle which is almost equilateral. Some of the tetrahedrally coordinated Cu sites are statistically occupied. The structure determination leads to a correction of the chemical formula which had originally been given as $Pb_2(Cu,Fe)_{21}S_{12}$.

548.736

13940. THE CRYSTAL STRUCTURE OF $KAu(CN)_2$.
A.Rosenzweig and D.T.Cromer.
Acta cryst., Vol. 12, Pt 10, 709-12 (Oct., 1959).

$KAu(CN)_2$ is rhombohedral, space group R3̄, with a = 9.74 A and $\alpha = 43.9°$. The structure is similar to that of $KAg(CN)_2$ and consists of layers of linear $Au(CN)_2^-$ ions alternating with layers o K^+ ions. However, the stacking of the layers differs in the two compounds, so that $KAg(CN)_2$ is hexagonal and $KAu(CN)_2$ is rhomb hedral. A refinement of the structure was made by least-squares analysis of counter data. The Au—C bond is 2.12 ± 0.14 A, the C—N bond is 1.17 ± 0.20 A and the average K—N distance is 2.78 Twinned crystals of $KAu(CN)_2$ often occur and the nature of this twinning is discussed in detail.

548.736

13941. THE CRYSTAL STRUCTURE ANALYSIS OF ZIRCONIUM SULPHATE TETRAHYDRATE. J.Singer and D.T.Cromer.
Acta cryst., Vol. 12, Pt 10, 719-23 (Oct., 1959).

Zirconium sulphate tetrahydrate is orthorhombic, space grou Fddd, with a = 25.92, b = 11.62, c = 5.532 A, and has eight formula

per unit cell. The structure was determined by X-ray Fourier ods, and refined by least-squares, using data obtained from rical crystals with a Geiger counter. The structure consists yers of composition $Zr(SO_4)_2.4H_2O$ normal to the a axis. These s are probably held together by hydrogen bonds. The hydrate en and one of the sulphate oxygens form an antiprism about the nium atom at an average Zr–O distance of 2.180 A. The sul- group has a small but significant departure from tetrahedral netry, the two nonequivalent S–O bonds being 1.443 and 1.486 A, ±0.014 A. The relationship between this structure and that of ium (IV) sulphate tetrahydrate is discussed.

548.736.5

2. THE CRYSTAL STRUCTURE OF α-$Cu(NH_3)_2Br_2$. F.Hanic. cryst., Vol. 12, Pt 10, 739-44 (Oct., 1959). In German.

Two forms of $Cu(NH_3)_2Br_2$ exist. The α-form is monoclinic a = 8.18, b = 8.15, c = 4.05 A; $\beta = 94.8^0$; space group C2/m; 2. The structure of the cubic β-form has been previously ribed [Acta cryst., Vol. 11, Pt 9, 610-11 (Sept., 1958)]. The cture of α-$Cu(NH_3)_2Br_2$ was determined from its powder pattern the aid of special methods. Planar centrosymmetrical mole- s of $Cu(NH_3)_2Br_2$ are present, with Cu–Br: 2.54 A, Cu–N: 1.93 A, –Cu–N : 90^0. A close relation to the structure of β-$Cu(NH_3)_2Br_2$ so explained.

548.736.5

3. UNIT CELL AND SPACE GROUP OF URANYL ACETATE YDRATE, $UO_2(CH_3COO)_2.2H_2O$. V.Amirtha-Lingam, .Chandran and V.M.Padmanabhan. cryst., Vol. 12, Pt 10, 821-2 (Oct., 1959).

548.736.6

4. CHARGE BALANCE AND THE STABILITY OF ALKALI SPARS: A DISCUSSION. .Ferguson, R.J.Traill and W.H.Taylor. cryst., Vol. 12, Pt 10, 716-18 (Oct., 1959).

The analysis of the structures of low albite and high albite a cryst., Vol. 11, Pt 5, 331-48 (May, 1958)] led to the suggestion local balance of charge might be an important factor in deter- ing the stability of the K-felspars as appeared to be the case for Na-felspars. Difficulties in accepting this hypothesis, raised lacKenzie and Smith [Acta cryst., Vol. 12, Pt 1, 73-4 (Jan.,)] are discussed both in relation to the meaning of the hypothesis in its application to petrological data.

548.736.6

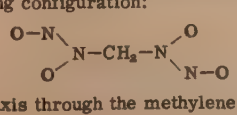
5. STRUCTURES OF SOME TETRAGONAL SHEET SILICATES. abst. a cryst., Vol. 12, Pt 10, 733-9 (Oct., 1959).

The phases $CaCuSi_4O_{10}$ ("Egyptian blue"), $SrCuSi_4O_{10}$ and $CuSi_4O_{10}$ have been grown in single crystals. Their structure, in space group P4/ncc, is similar to that of gillespite, $BaFeSi_4O_{10}$, viously established (1943). The parameters of the structure e determined for $CaCuSi_4O_{10}$ by means of repeated electron- sity projections on to (100) and (110) followed by further adjust- nts. Gillespite is not known in good crystals. Each of the three ficial materials was obtained in measurable crystals showing forms {001}, {101}, and {110} in the order of prominence predic- by the rule of Donnay and Harker (1937). Gillespite is easily cked by mineral acids. The copper analogues are impervious ttack. This may be attributed to the superior stability of copper -fold planar coordination. Such coordination is characteristic ivalent copper but exceptional for ferrous iron. It seems ɔable that the imperfectly described mineral cuprorivaite is the ural analogue of "Egyptian blue".

548.737

6. THE CRYSTAL STRUCTURE OF THE DIPOTASSIUM LT OF METHYLENE-BIS-NITROSOHYDROXYLAMINE, $(N_2O_2K)_2$. J.H.Bryden a cryst., Vol. 12, Pt 8, 581-5 (Aug., 1959).

The crystals are orthorhombic, having the unit-cell dimensions = 26.40, $b_0 = 12.81$ and $c_0 = 3.95$ A. The space group is Fdd2, there are eight molecules per unit cell. The structure was uced and refined by Fourier and least-squares methods. The on has the following configuration:



re is a two-fold axis through the methylene group. The N–CH_2–N bond angle is slightly less than tetrahedral. Resonance occurs among the N–N and N–O bonds, and accordingly the CN_2O_2 grouping is nearly planar. The CH_2–N bond is significantly longer than the usual carbon–nitrogen single bond length.

548.737

13947. THE CRYSTAL STRUCTURES OF THE DIBROMIDE AND DI-IODIDE OF 5 : 10-DIHYDRO-5 : 10-DIMETHYLARSANTHREN. D.J.Sutor and F.R.Harper.
Acta cryst., Vol. 12, Pt 8, 585-9 (Aug., 1959).

The dibromide of 5 : 10-dihydro-5 : 10-dimethylarsanthren crystallizes in the orthorhombic space group $P2_12_12_1$ with unit-cell dimensions a = 11.27, b = 9.70, c = 14.87 A, while the di-iodide crystallizes in the monoclinic space group $P2_1/c$ with a = 10.63, b = 9.94, c = 17.02 A, $\beta = 108.6^0$. The coordinates of the heavy atoms were determined from the h0l and 0kl sharpened Patterson projections and refined by Fourier syntheses; coordinates for the carbon atoms of the arsanthren ring and probable coordinates for the methyl groups in the dibromide were obtained from difference syntheses. The stereochemistry is similar for the two molecules; they are folded about the As–As axis and the two halogen atoms are disposed one on each side of one arsenic atom, the line joining the halogen atoms being at right angles to the plane which contains the three As–C bonds of this arsenic atom. The valencies of the other arsenic atom are probably non-planar, as in other 3-covalent arsenic compounds, though a planar configuration cannot be definitely excluded. The As–Br and As–I bonds are significantly longer than covalent bonds and may be either ionic or intermediate between ionic and covalent.

548.737

13948. THE CRYSTAL STRUCTURES OF SOME MESITYLENE AND DURENE DERIVATIVES. II. NITROMESITYLENE. J.Trotter.
Acta cryst. Vol. 12, Pt 8 605-7 (Aug., 1959).

For previous work see Acta cryst., Vol. 12, Pt 2, 173 (Feb., 1959). Crystals of nitromesitylene are orthorhombic, space group $Pna2_1$, with four molecules in the unit cell. The structure was determined from projections along the three principal crystallographic axes and values of the molecular dimensions and intermolecular distances were obtained. The nitro group is tilted about the C–N bond 66^0 out of the plane of the aromatic ring.

548.737

13949. THE CRYSTAL STRUCTURE OF COBALT(II) BISACETYLACETONE DIHYDRATE. G.J.Bullen.
Acta cryst., Vol. 12, Pt 10, 703-8 (Oct., 1959).

Cobalt(II) bisacetylacetone dihydrate, $Co(C_5H_7O_2)_2.2H_2O$, is monoclinic, a = 10.91, b = 5.39, c = 11.19 A, $\beta = 106.0^0$, space group $P2_1/c$, two centrosymmetric molecules in the unit cell. The atomic positions were determined by Fourier and least-squares refinement of X-ray diffraction data. The cobalt atom, lying on a centre of symmetry, is surrounded by four oxygen atoms of the acetylacetone chelate groups and two water molecules, forming a tetragonally distorted octahedron (Co–O 2.05, 2.6 A; Co–H_2O 2.23 A). The atoms of the acetylacetone group are very nearly coplanar but the cobalt atom lies 0.4 A from their plane. The molecules are bound in layers by O ... H–O hydrogen bonds of length 2.90–2.91 A; between the layers are van der Waals forces.

548.737

13950. THE CRYSTAL STRUCTURE OF BIS-THIOUREA-LEAD(II) CHLORIDE. M.Nardelli and G.Fava.
Acta cryst., Vol. 12, Pt.10, 727-32 (Oct., 1959).

X-ray analysis of the crystal structure of bis-thiourea-lead (II) chloride, $Pb[SC(NH_2)_2]_2Cl_2$, has shown that the rather uncommon coordination number of seven for lead occurs in this compound. The lead atom is bonded to four sulphur and two chlorine atoms at the corners of a distorted trigonal prism, and to a chlorine atom near the centre of a lateral face. The coordination polyhedra, sharing their bases, form polymeric chains running along the shortest axis, [010]. The study of the two-dimensional Fourier projection on (010) and of the three-dimensional Fourier lines parallel to [010] gave the following mean values of bond lengths: Pb–S = 3.02 ± 0.05 A, Pb–Cl_I = 2.75 ± 0.04 A, Pb–Cl_{II} = 3.22 ± ± 0.06 A.

548.737

13951. THE CRYSTAL STRUCTURE OF 4,4-TRANS-AZOPYRIDINE-N-OXIDE. E.L.Eichhorn.

A 7

Acta. cryst., Vol. 12, Pt 10, 746-54 (Oct., 1959).

Investigation of this azo-derivative was undertaken as a sequal to that of the 4-nitro-compound (Eichhorn, 1956). Whereas marked quinoidal character was found in the nitro-derivative, resonance of aromatic ring character appears to be restored to the pyridine ring by diazotization. A three-dimensional refinement of the crystal structure was carried to a percentage discrepancy of $R_{21\Omega}$ = 15.2%, with e.s.d. values for the atomic positions ranging between 0.0044 and 0.0096 A. The molecule is flat, with the azo bond across a centre of symmetry, which was chosen as origin. The space-group is $P2_1/n$; there are two molecules per unit cell.

548.737

13952. THE CRYSTAL STRUCTURE OF CIS D,L 11-12 METHYLENE OCTADECANOIC ACID. B.Craven and G.A.Jeffrey.
Acta cryst., Vol. 12, Pt 10, 754-61 (Oct., 1959).

The crystal structure was determined by two-dimensional Fourier synthesis of the (h0l) and (0kl) diffraction data. In contrast, to the "straight chain" stereochemistry found in the previously studied C_{19} trans cyclopropane acid, this molecule is bent at the cis substituted ring so as to have an overall shape somewhat like that of a boomerang. This compound is believed to be the racemate of the naturally occurring lactobacillic acid and is analogous to dihydrosterculic acid, in which the cis ring is in the 9-10 position.

548.737

13953. ON THE CRYSTAL STRUCTURE OF AUREOMYCIN HYDROCHLORIDE. S.Hirokawa, Y.Okaya, F.M.Lovell and R.Pepinsky.
Acta cryst., Vol. 12, Pt 10, 811-13 (Oct., 1959).

548.737

13954. STRUCTURE OF TRANS $(CH_3NO)_2$.
M.Van Meerssche and G.Germain.
Acta cryst., Vol. 12, Pt 10, 818 (Oct., 1959). In French.

548.737

13955. THE STRUCTURE OF CRYSTALS CONTAINING A HYDROGEN-BONDED COMPLEX OF 1-METHYLTHYMINE AND 9-METHYLADENINE. K.Hoogsteen.
Acta cryst., Vol. 12, Pt 10, 822-3 (Oct., 1959).

548.737

13956. STRUCTURE OF MIXED CRYSTALS IN THE SYSTEM ANTHRACENE–PHENANTHRENE.
A.I.Kitaigorodskii and V.M.Kozhin.
Kristallografiya, Vol. 4, No. 2, 209-13 (March-April, 1959).
In Russian.

The method of preparing the mixed crystals is described and the constitution diagram of the system is given. The parameters of the elementary cells of anthracene, phenanthrene and a mixed crystal containing 80% of anthracene are determined; the geometrical conditions for the introduction of phenanthrene into the anthracene lattice are analysed. R.F.S.Hearmon

548.737 : 539.19

13957. EVIDENCE FOR A SECOND CRYSTAL FORM OF POLYPROPYLENE.
H.D.Keith, F.J.Padden, Jr, N.W.Walter and H.W.Wyckoff.
J. appl. Phys., Vol. 30, No. 10, 1485-8 (Oct., 1959).

An attempt is made to account for the observed briefringence of the various types of polypropylene spherulite in terms of preferred crystalline orientation. Evidence is also presented showing that some of these spherulites crystallize with a new metastable crystal structure, not previously described.

548.737 : 537.226.2

13958. CRYSTAL STRUCTURE OF THE FERROELECTRIC PHASE OF $(GLYCINE)_3.H_2SO_4$.
S.Hoshino, Y.Okaya and R.Pepinsky.
Phys. Rev., Vol. 115, No. 2, 323-30 (July 15, 1959).

Ferroelectric $(glycine)_3.H_2SO_4$ crystallizes at room temperature in the monoclinic system with a = 9.41$_7$ A, b = 12.64$_3$ A, c = 5.73$_5$ A, β = 110° 23'; the space group is $P2_1$, and the polar direction is along the two-fold screw axis. Above 47°C the spontaneous polarization disappears as the space group becomes $P2_1/m$. The crystal structure was determined from full three-dimensional X-ray diffraction data, using Cu Kα radiation. Out of the three glycine molecules in the crystal, one has the usual zwitter-ion configuration, with the $-NH_3^+$ group out of the plane of the other atoms; the remaining two glycine are mono-protonated, and planar with experimental error, and are designated as glycinium ions. Thus the chemical formula is properly written as $(NH_3^+CH_2COO^-)$. $(NH_3^+CH_2COOH)_2$. SO_4^{--}, and the compound is best described by the chemical name glycine diglycinium sulphate. On of the planar glycinium ions lie near but not in the plane y = $\frac{1}{4}$, which becomes the mirror plane in the high-temperature phase. The nitrogen atoms form N–H . . O hydrogen bonds of the usual strength, whereas a quite strong O–H . . O hydrogen bond of adistance of 2.43$_8$ A is found between the oxygen atom of the carboxyl group of the zwitter-ion type glycine and that of the planar glycinium ion which lies near the plane y = $\frac{1}{4}$. Above the Curie point, at 47°C, mirror symmetry is attained by statistical arrangement of atoms around the mirror planes at y = $\frac{1}{4}$ and $\frac{3}{4}$. The disorder of the glycinium ions near the mirror planes, and the above mentioned strong O–H . . O bond, are of particular importance for the ferroelectric behaviour of the crystal.

548.7

13959. STUDY OF METALLIC CARBIDES BY ELECTRON DIFFRACTION. II. CRYSTAL STRUCTURE ANALYSIS OF NICKEL CARBIDE. S.Nagakura.
J. Phys. Soc. Japan, Vol. 13, No. 9, 1005-14 (Sept., 1958).

For Pt I, see Abstr. 8475 (1958). The observed intensity show considerable primary extinction and this was corrected, using Wilson's intensity statistics combined with the theory of primary extinction (Abstr. 7654 of 1959). The procedure is described in detail and it is concluded that the structure of nickel carbide belon to the space group R3c, and that nickel atoms occupy 18e positions with the parameter x = 1/3, and carbon atoms 6b positions. It was found also that the carbon atoms take a kind of one-dimensionally disordered arrangement in the carbide lattice.

548.

13960. STUDY OF METALLIC CARBIDES BY ELECTRON DIFFRACTION. III. IRON CARBIDES. S.Nagakura.
J. Phys. Soc. Japan, Vol. 14, No. 2, 186-95 (Feb., 1959).

For Pt II, see preceding abstract. Thin iron films formed by evaporation were carburized in a CO gas stream. The carbides ϵ, χ and θ were found to be formed in the temperature ranges (1) below 250°C, (2) from 250° to 350°C, and (3) above 350°C, respectively. The ϵ-carbide is hexagonal with lattice constants a = 4.767 A and c = 4.354 A, and its structure belongs to the space group $P6_322$, iron atoms occupying 6g positions with the parameter x = 1/3 and carbon atoms 2d positions. Irreversible phase transitions from ϵ to χ and from χ to θ take place at 380° ~ 400°C and at about 550°C, respectively. By the transitions, changes in the chemical compositions may be very small. Observation on the crystal growth suggests that a mechanism of the ϵ-carbide formation is different from that of the χ- and θ- carbide formations.

548.74 : 539.

13961. ELECTRON DIFFRACTION STUDY OF EVAPORATED FACE-CENTERED CUBIC CRYSTALLITES. H.Morimoto.
J. Phys. Soc. Japan, Vol. 13, No. 9, 1015-30 (Sept., 1958).

By radial distribution analysis, Kimoto's conclusion (Abstr. 4033 of 1954) is confirmed. Intensities of diffraction patterns from evaporated silver were accurately measured by the sector-microphotometer method and were converted to radial distribution functions. These functions reveal anomalous peaks caused by stacking faults. After a specimen was annealed at 350°C for 3.5 hr, although crystallites did not grow remarkably, these peaks disappeared. The amplitude of thermal vibration was found to be 0.15 ± 0.02 A, which agrees well with that for a silver crystal. The narrowing of the first neighbour peak was found, and is attributed to the correlative thermal vibration. Gold shows the same anomaly, but aluminium does not. These facts are in accordance with the value for the stacking-fault energy.

548.

13962. THE MEASUREMENT OF LATTICE SPACINGS FROM AN ELECTRON-DIFFRACTION PICTURE. S.Yamaguchi.
Naturwissenschaften, Vol. 46, No. 15, 472 (1959). In German.

If the wavelength of incident electrons is varied between known limits during an exposure, it is unnecessary to know the position of the undeflected beam on the photograph. A.R.Stok

548.

13963. A NEUTRON-DIFFRACTION STUDY OF POTASSIUM COBALTICYANIDE. N.A.Curry and W.A.Runciman.
Acta cryst., Vol. 12, Pt 9, 674-8 (Sept., 1959).

The methods of neutron diffraction, which permit a distinction

ade between carbon and nitrogen atoms, was used to extend the .er X-ray studies of $K_3Co(CN)_6$. It appears that the carbon atoms .n positions adjacent to the cobalt ions. The methods of Fourier synthesis and least squares was used to obtain improved atomic coordinates and values for the Debye–Waller temperature factors. The length of the C–N bonds is 1.15 A.

GEOPHYSICS

550.38 : 532.5 : 538.3

THE INTERACTION OF CONDUCTIVE PARTICLE STREAMS H THE EARTH'S MAGNETIC FIELD. See Abstr. 13499

550.382

4. THERMO-REMANENT MAGNETIZATION (TRM) OF LTIDOMAIN GRAINS IN IGNEOUS ROCKS. F.D.Stacey. . Mag. (Eighth Ser.), Vol. 3, 1391-401 (Dec., 1958).

The magnetic moment of a multidomain grain at its blocking perature is determined by the domain arrangement which gives minimum magnetic energy; for a large grain the energy mum is produced by a self-demagnetizing field equal and site to the external field. Below the blocking temperature the ain configuration is frozen in and the moment increases with the easing spontaneous magnetization. This results in a TRM portional to small inducing fields, as in the theory of single ain grains and as required for agreement with experimental rvations. Artificial TRM's of 17 rocks for which analyses of netic minerals are available show good agreement with ulated values. The theory also gives a formula for the maximum ible initial susceptibility of rocks which agrees well with rimental observations.

550.385 : 551.510.535

5. GEOMAGNETIC STORMS AND IONOSPHERIC DISTURBES. T.Obayashi. adio Res. Lab. (Toyko), Vol. 6, 375-514 (June, 1959).

After an introduction, consisting of a general survey, the current epts of the disturbances in the terrestrial ionosphere are cored and the states of the present problems are described. These discussed in three sections. (I) Morphology of geomagnetic and spheric storms; (II) Dynamo theory of magnetic storms; Geomagnetic storms and the earth's outer atmosphere.

550.385 : 551.594.5

AURORAL HYDROGEN EMISSION AND THE MAGNETIC CURBANCE. See Abstr. 12912

551.16 : 536.421.1

FUSION CURVE OF IRON TO 96 000 ATMOSPHERES: IPERATURE OF THE EARTH'S CORE. See Abstr. 13222

551.311.12

6. DENSITY OF GLACIER ICE. P.A.Shumskii. l. Akad. Nauk SSSR, Vol. 126, No. 4, 767-70 (June 1, 1959). ussian.

Assuming the perfectly elastic nature of the processes of compression and expansion of glacier ice, the author derives an ression for the density of that ice at a given temperature and sure and for the depth corresponding with that pressure. As, ever, in polycrystalline ice with air inclusions, the processes uestion are neither purely elastic nor completely reversible, the ribution of density in the case of a relatively rapid accumulation blation of ice can be only determined empirically. Assuming the density distribution curve is a portion of the parabola of degree, the author derives expressions for, inter alia: pressure epth z; gradient of compression of ice; compression at depth z pared to compression at the surface; age of ice; rate of sinking e ; rate of compression of ice; rate of relative compression of F.Lachman

ATMOSPHERE . IONOSPHERE

551.508.71 : 533.275

METHODS FOR MEASURING THE HUMIDITY OF AIR. See Abstr. 13073

551.510.4 : 523.4

THE DISSIPATION OF HYDROGEN FROM PLANETARY ATMOSPHERES. See Abstr. 12955

551.510.41

13967. THE ABUNDANCE OF ATMOSPHERIC CARBON MONOXIDE ABOVE COLUMBUS, OHIO. J.H.Shaw. Astrophys. J., Vol. 128, No. 2, 428-40 (Sept., 1958).

From measurements of the line R(3) of the 4.7 μ fundamental band appearing in the solar spectrum, the usual CO content of the atmosphere during 1952-53 has been found to be between 0.04 and 0.07 atm cm per air mass. There is evidence for some increase in CO content on occasional days during the colder months of the year, but, because the line measured is contaminated by a weak H_2O absorption, it is not possible to show that similar increases also occur during the summer months. The occasions of high CO content are usually associated with periods of low visibility and usually occur during the early part of the day. This is especially true of the period October 20-November 13, 1952, when the worst forest fires for twenty years were burning in south-eastern Ohio and states further south. The present data are compared with the results of other workers.

551.510.535

RADIO-WAVE PROPAGATION IN THE IONOSPHERE. See also the Section entitled "ELECTROMAGNETIC WAVES AND OSCILLATIONS".

551.521.3

13968. PHOTOELECTRIC MEASUREMENTS OF THE SCATTERING INDEX IN THE GROUND LAYER OF THE ATMOSPHERE. P.N.Boiko, G.Sh.Livshits and T.P.Toropova. Dokl. Akad. Nauk SSSR, Vol 124, No. 4, 803-5 (1959). In Russian.

The authors used a searchlight and, using a photoelectric photometer of special design, measured the brightness of the light scattered in various directions with respect to the beam. The Rayleigh scattering was also calculated. At smaller angles (0-10°) the Rayleigh scattering is from 1 to 2 orders smaller than that found experimentally whilst at large angles (~ 90°) it is up to 1 order smaller. C.R.S.Manders

551.521.326 : 523.161

INTERPLANETARY GAS HYDROGEN RADIATION IN THE NIGHT SKY. See Abstr. 12944

551.521.9 : 537.591.8

13969. POSSIBLE MECHANISM OF PRODUCTION OF "TERRESTRIAL CORPUSCULAR RADIATION" UNDER THE ACTION OF COSMIC RAYS. S.N.Vernov, N.L.Grigorov, I.P.Ivanenko, A.I.Lebedinskii, V.S.Murzin and A.E.Chudakov. Dokl. Akad. Nauk SSSR, Vol. 124, No. 5, 1022-5 (Feb. 11, 1959). In Russian.

A quantitative theory to justify the presence of the Van Allen layers (called by the authors terrestrial corpuscular radiation), based on the assumption of a trapping and storing mechanism, by the earth's magnetic field, of the decay products of cosmic-ray neutrons at high altitudes. In the calculations it is assumed that the earth's magnetic field can be represented by a perfect dipole field. G.Martelli

551.521.9

13970. CAUSE OF THE MINIMUM IN THE EARTH'S RADIATION BELT. S.F.Singer.
Phys. Rev. Letters, Vol. 3, No. 4, 188-90 (Aug. 15, 1959).

The anticipated altitude variation of the intensity of the equatorial radiation belt was calculated, assuming that it consists of protons arising from the decay of upward-moving cosmic ray neutrons originating in the earth's atmosphere. Assuming that the particle lifetime is primarily controlled by atmospheric density at low altitudes, but is limited by additional factors at higher altitudes, a maximum of intensity is found at 1.5 earth radii. This is in good agreement with experimental space probe results for the height of the first radiation maximum. It is suggested that the second maximum found at 3-4 earth radii can be identified with solar corpuscular radiation. G.M.Brown

551.575

13971. INFLUENCE OF AIR MOVEMENTS ON COALESCENCE IN CLOUDS AND MISTS. I. THE CASE OF ACCELERATED MOTION. A.Grigoriu, G.Giurgea and L.Stăniloae.
Rev. de Physique (Bucarest), Vol. 3, No. 3-4, 247-54 (1958).
In French.

Theoretical considerations are given of the processes of drop coalescence in clouds and mists for the cases of paths in a pure gravitational field and subjected to uniformly accelerated air motion. For the latter, it is found that the region where the coalescence is increased as the result of the air motion is more extended than that in which it is hindered, leading to a net intensification of coalescence. These results are clearly important in considering the role played by interior macroturbulence in clouds, and also in possible acoustical means of dissipating fog or artifically stimulating rainfall. G.M.Brown

551.578.4

13972. POLAR SNOW. F.Ya.Klinov.
Izv. Akad. Nauk SSSR, Ser. geofiz., 1958, No. 6, 796-9. In Russian. English summary: PB 141042T-2, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

The structure of polar snow (i.e. ice crystals forming snow flakes in the atmosphere at temperatures $< -40^{\circ}$ C), as observed by the author in Verkhoyansk during 1952-54 is described and the shapes of the crystals are illustrated. Sizes varied up to 800 μ. The variety in the forms of flakes is caused by the heterogeneous conditions accompanying the production of ice crystals. It is possible to forecast the type of falling snow by considering the general synoptic situation. Observations carried out during February 1954 of the Moon's haloes and of snow flakes collected on glass gave interesting results which are of value for the understanding of the mechanism of snow formation. S.Weintrou

551.594.1

13973. DETERMINING THE RADIOACTIVITY IN EARTH, WATER AND AIR. I. H.Israël.
Arch. tech. Messen, No. 277, (Ref. V655-3), 27-30 (Feb., 1959).
In German.

The amount of natural radioactive material in the earth's crust and atmosphere, and the three principles on which measurements are commonly based (ionization, excitation of fluorescent materials trails on photographic plates) are briefly reviewed. Older measuring units, and their numerical relations to the present unit (Curie) are given, and the unit used for γ-radiation (Röntgen) is defined. Ionization measurements and the determination of radon in air are briefly discussed. C.F.Pizzey

551.594.6 : 538.561 : 621.396.82

13974. ORIGIN OF "VERY-LOW-FREQUENCY EMISSIONS". R.M.Gallet and R.A.Helliwell.
J. Res. Nat. Bur. Stand., Vol. 63D, No. 1, 21-7 (July-Aug., 1959).

Selective travelling-wave amplification in the outer ionosphere is postulated to explain very-low-frequency emissions, a class of very low-frequency (1 to 30 kc/s) natural noise. By analogy with the mechanism of travelling wave tubes, low-level ambient noise in the outer ionosphere is amplified in streams of incoming ionized solar particles at frequencies for which the stream and wave velocities are equal. Required velocities are in the range of 0.01 to 0.1 c (where c is the velocity of light). Streams with densities of the order of 1 electron/cm^3 would provide sufficient energy. Phenomena which can be explained qualitatively by the theory are the hiss, quasi-constant tones, dawn chorus and related transients, and very long trains of whistler echoes. A quantitative example shows how the theory can reproduce the general form of certain characteristic discrete spectra "hooks" of emissions, and how this leads to definite values of particle velocity and a law for the distribution of electron density in the outer ionosphere.

BIOPHYSICS
PHYSIOLOGICAL PHYSICS

574 : 778.34

THE METHOD OF "TRACK-HISTOPHOTOGRAPHY". See Abstr. 14015.

591.18

13975. HYDROSTATIC BALANCING MECHANISM OF XENOPUS LARVAE. W.A.van Bergeijk.
J. Acoust. Soc. Amer., Vol. 31, No. 10, 1340-7 (Oct., 1959).

Experiments are described which show that larvae of the South African clawed toad Xenopus possess a reflex mechanism which enables them to maintain a stable position in the water, independent of hydrostatic pressure. From observations on the behaviour of the animals and recordings from the saccular macula of the ear, the conclusion is drawn that the lung of the animal generates an a.c. signal, which is frequency modulated by the hydrostatic pressure. This signal is transmitted to the ear, and is utilized to maintain balance. A conceptual model for the reflex is proposed.

61 : 778.34

MEDICAL APPLICATIONS OF THE "TRACK-HISTOPHOTOGRAPHY" METHOD. See Abstr. 14016.

612.843

13976. NEW VISUAL PHENOMENON: THE GREENISH-YELLOW BLOTCH. W.A.Shurcliff.
J. Opt. Soc. Amer., Vol. 49, No. 11, 1041-8 (Nov., 1959).

An observer, viewing only a uniform physical field, finds that his perceptual field suddenly becomes broken up into areas (called pattern and background) that exhibit two very different colours. The pattern arises suddenly, and lasts only a few sec. It has an irregular blotchy shape and may be 45° or more in width (becoming smaller in successive experiments and finally remaining absent entirely). The creation of the pattern depends on the spectral energy distribution (not the colour) of the physical field. Wavelengths near 570 and 470 mμ play crucial and antithetical roles. The colour of the pattern depends on the spectral distribution of the physical field being viewed currently. The colour is neither similar to nor complementary to that of the background or any preceding field. To tie together the wealth of observations as to colour, duration and sequence effects of the patterns, one may postulate that the perceptual field-of-view is governed (as regards yellowness/blueness ratio only) by hundreds of radiation-actuated switches arranged in parallel. Each switch is of three-position type, and can produce normal yellowness/blueness ratio, extremely high (anomalous) ratio, or extremely low (anomalous) ratio. By referring to the postulated design of the switch, an investigator can predict the results of nearly any pertinent experiment.

612.84

13977. COLOR IDENTIFICATION AS A FUNCTION OF EXTENDED PRACTICE. R.M.Hanes and M.V.Rhoades.
J. Opt. Soc. Amer., Vol. 49, No. 11, 1060-4 (Nov., 1959).

The use of colour as a coding device has been limited in some important applications because a practical maximum of only about 15 absolutely identifiable colours has been found experimentally.

investigation was undertaken to determine whether or not
:antial improvement in colour identification could be obtained
result of extended practice. One subject practised on Munsell
ır chips for about five months. Performance improved
nuously, and at the end of the practice period the subject was
to identify 50 colours with almost perfect accuracy. However,
rs increased markedly during three months of no practice
ediately following the training period.

612.843

3 EARLY DARK ADAPTATION TO DIM LUMINANCES.
Baker, M.D.Doran and K.E.Miller.
ɔt. Soc. Amer., Vol. 49, No. 11, 1065-70 (Nov., 1959).
Visual threshold changes were measured just before and just
a preadapting light was dimmed to several luminance levels.
course of the sensitivity change is similar whether the eye is
ting to darkness or to a light which is merely dimmed. The
r features of the early dark adaptation curve are (1) a small
in the threshold when the preadapting light is turned off, and
n abrupt subsequent drop which slows into the familiar dark
tation curve. These two features are influenced by the luminance
th the preadapting and adapting lights. The locus of the effect
scussed as being probably in the receptor itself, and the
ications of this suggestion are considered.

612.85

9. MULTIPLE OBSERVERS, MESSAGE RECEPTION, AND
ING SCALES. L.R.Decker and I.Pollack.
coust. Soc. Amer., Vol. 31, No. 10, 1327-8 (Oct., 1959).
The improvement of message reception in noise with multiple
rvers was analysed. Two sets of decision rules were employed
lect among the responses of three observers as follows: one
d upon the response agreement among observers; one based upon
isteners' confidence ratings of accuracy of message reception.
idence ratings substantially improved the selection of the
ect message reception in the absence of response agreement
ng observers.

612.85 : 616.89

0. EFFECT OF BRIEF LOUD NOISE ON DECISION MAKING.
.Woodhead.
coust. Soc. Amer., Vol. 31, No. 10, 1329-31 (Oct., 1959).
An experiment was designed to investigate whether irrelevant
bursts of low frequency noise affected decision-making un-
urably. Analysis of the results revealed a significant decre-
t in performance due to the noise distraction. Scores for the
e of a 4 min test were unimpaired because only those responses
ediately following the noise were affected. A second experiment
onstrated that effects were related to intensity.

612.85

13981. CONTINUITY EFFECTS WITH ALTERNATELY SOUNDING TONES. W.R.Thurlow and L.F.Elfner.
J. Acoust. Soc. Amer., Vol. 31, No. 10, 1337-9 (Oct., 1959).

The present experiments investigated the conditions under which one of two alternating tones can be made to sound continuous. When one tone, B, of 21 msec duration, was sounded alternately with a tone, A, 11.3 times per sec, tone A appeared to sound continuous if tone B was made 10 to 20 dB higher in sensation level than tone A. The intensity required to produce the "continuity" effect was found to be least when tone B was near to tone A in frequency. The continuity of tone A could be broken, however, by increasing the off-time of tone A (which also increased the on-time of tone B). To measure this more precisely, duration of interruption (off-time) of tone A was varied, and continuity thresholds were obtained for tone A alternating with tone B, when B was set near in frequency to A and at 15 dB higher sensation level. It was found that tone A sounded continuous with longer off-times when tone B was present during the interruptions than when it was absent. Certain of these thresholds varied as a function of the rate at which tones A and B were alternated.

612.85

13982. DISCRIMINATION OF NUMBER OF SIMULTANEOUSLY SOUNDING TONES. W.R.Thurlow and I.L.Rawlings.
J. Acoust. Soc. Amer., Vol. 31, No. 10, 1332-6 (Oct., 1959).

The aim of the present experiments was to investigate the accuracy with which the number of simultaneously sounding tones can be perceived. Various one-, two-, and three-tone stimuli were presented to subjects, who had to judge how many tones were present. Results showed that discrimination of number of different tones sounding was far from perfect (even though Ohm's acoustic law would lead us to expect high accuracy). The discrimination of the average person was not improved even when frequency components were widely spaced. Accuracy of perception was poorer for two- and three-tone combinations than for one-tone stimuli. Number of allowable response categories also affected percent correct responses. Individual differences in performance were found to be large.

612.858

13983. EFFECT OF EARPHONE CUSHION ON AUDITORY THRESHOLD. J.F.Jerger and T.W.Tillman.
J. Acoust. Soc. Amer., Vol. 31, No. 9, 1264 (Sept., 1959).

This is reported for a Permaflux earphone type PDR-10 mounted in three types of cushion (MX 41/AR, NAF-48490-1, and CZW-6). Five experienced listeners listening to $\frac{1}{2}$ sec pulsed tones repeated once per sec, measured the thresholds by the method of adjustment.

H.D.Parbrook

TECHNIQUE . MATERIALS

621-762 : 620.179.1

13984. STRESS PHENOMENA IN GLASS-TO-GLASS AND GLASS-TO-METAL SEALS. A.M.Kruithof.
Ned. Tijdschr. Natuurkde, Vol. 24, No. 12, 301-14 (Dec., 1958). In Dutch.

The ability to make glass-to-glass and glass-to-metal seals is determined by strain phenomena, and therefore a mere knowledge of the expansion coefficient is inadequate. Strain measurements with polarized light on proposed standard test pieces are described. Elasticity and stress relieving properties of glass at joints are discussed. T.Mulvey

621.92 : 539.576

ULTRASONIC MACHINING WITH BORON CARBIDE SUSPENSION. See Abstr. 13868

669.2

13985. THE POWDER METALLURGY OF URANIUM.
H.H.Hausner and J.L.Zambrow.
Nuclear Sci. Engng, Vol. 1, No. 1, 92-101 (March, 1956).

Uranium powder can readily be prepared by hydriding solid uranium and by the decomposition of the hydride. The powder particles are of –325 mesh size. This powder compacts to density varying between 12 and 14 g/cm^3. Sintering subsequent to compacting results in a material of high strength characterized by a slight porosity and coarse grain structure. Hot pressing uranium powder in the alpha temperature range at pressures of approximately 10 to 15.tons/in^2. results in a material of perfect density and a small grain structure. Hot compacting uranium powder is a process perfectly feasible for production.

PHOTOGRAPHY

771.531

13986. EQUIVALENT QUANTUM-EFFICIENCIES OF PHOTOGRAPHIC EMULSIONS. P.Fellgett.
Monthly Not. Roy. Astron. Soc., Vol. 118, No. 3, 224-33 (1958).

Signal-to-noise equivalent numbers of stored photons and equivalent quantum-efficiencies are derived for four emulsion batches from homogeneous sensitometry and granularity data. The highest monochromatic efficiencies found are 0.9% in the blue and 0.6% in the red. Peak efficiencies occur at densities of only 0.1 to 0.2 above fog. The peak equivalent number of photons stored ranges from 0.03 per μ^2 for the "fastest" emulsion in the blue to 0.4 per μ^2 for the finest grained material in the red. The distinction between exposure for maximum efficiency and for maximum equivalent storage is emphasized.

778.33

13987. SINGULAR AND COLLECTIVE PHENOMENA IN X-RAY PHOTOGRAPHY. H.Tellez-Plasencia.
"Particle photography" conference, Strasbourg, 1957 (see Abstr. 11704 of 1959) pp. 71-83. In French.

A statistical study is made of the action of a large number of photons incident on an aggregate of silver halide grains, the emulsion being considered as a homogeneous medium. Mean results are thereby established in complete ignorance of individual processes contributing to the formation of an image. In this approach frequent use is made of ideas pertaining to the domain of single corpuscular processes. It is concluded that under the conditions of such experiments the probability of rendering a grain developable is no longer a simple function of the number of absorbed photons or of electron impacts on the grains, but that the number of liberated silver atoms within a grain and their state of distribution must be considered also. S.J.St-Lorant

778.33 : 669

13988. SOME EXAMPLES OF THE APPLICATION OF AUTORADIOGRAPHY IN METALLURGY. H.Faraggi.
"Particle photography" conference, Strasbourg, 1957 (see Abstr. 11704 of 1959) pp. 409-16. In French.

An outline of the methods available in the study of alloys and their properties is given, insofar as these make use of nuclear emulsions. The paper describes contact autoradiography and subdivides the process into detection, localization and dosimetry. Ea section is discussed separately and illustrated with some example No quantitative results are presented but suggestions are made fo increasing the scope of the method by wider recourse to the exten properties of present nuclear emulsions. S.J.St-Lor

778.

13989. DIRECT APPROACH TO QUANTITATIVE AUTORADIOGRAPHY. R.K.Poddar.
J. appl. Phys., Vol. 30, No. 10, 1539-41 (Oct., 1959).

Several physical factors which influence an autoradiographic image produced by radioactive inclusions in thin experimental specimens have been correlated through a semiempirical formula. The latter may be used to estimate the concentration of a radioisotope in a specimen from microscopic measurement of grain density in its autoradiograph, if the period of exposure, sensitivity of the photgraphic emulsion, and the actual geometrical arrangeme of the experiment are known.

778.

13990. ON THE THEORY OF FLUCTUATIONS OF THE SENSITIVITY OF THE CRYSTALS OF NUCLEAR PHOTOGRAPHIC EMULSIONS. G.I.Zel'tser and A.L.Kartuzhanskii.
Dokl. Akad. Nauk SSSR, Vol. 123, No. 3, 495-7 (1958). In Russian.

An elementary treatment of the fluctuations of grain formatio in nuclear emulsions. The results, when some parameters are adjusted, agree with the measurements performed on two types of emulsions. G.Mart

778.34 : 531.715

13991. GAP MEASUREMENT: APPARATUS FOR THE SEMI-AUTOMATIC MEASUREMENT OF MEAN LENGTHS AND LENGTH DISTRIBUTION OF GAPS IN NUCLEAR EMULSIONS.
R.Weill, C.Joseph, M.Gailloud and P.Rosselet.
Helv. phys. Acta, Vol. 31, No. 5, 546-50 (1958). In French.

The plate to be measured is traversed across the stage of a microscope by a synchronous motor which also provides electrical impulses at regular intervals. As the first and last edges of a gap cross the crosswire, the observer closes and opens (respectively) switch; the number of impulses in this interval is recorded and denotes the gap length, in units of 0.74 μ. The numbers of gaps o various lengths are recorded and agree well with micrometric measurements. G.F.Lothia

778.3

13992. DEVELOPING FAULTS USING AN AMIDOL DEVELOPER. THE EFFECT OF SODIUM SULPHITE CONCENTRATION, TEMPERATURE AND DURATION OF DEVELOPMENT.
G.D.Fatzer, R.Weill, M.Gailloud and C.Haenny.
"Particle photography" conference, Strasbourg, 1957 (see Abstr. 11704 of 1959) pp. 273-7. In French.

The optimum conditions for diathermal development of Ilford G5 emulsion are determined. Three amidol developers containing different amounts of sulphite are tested over a range of temperatur from 5° to 25°C and the influence on grain size and background fog density studied as a function of the duration of the development. S.J.St-Loran

778.3

13993. THE PREPARATION AND PROPERTIES OF NUCLEAR EMULSIONS CONTAINING PURE SILVER CHLORIDE.
H.Gauvin and W.Sebaoun.
"Particle photography" conference, Strasbourg, 1957 (see Abstr. 11704 of 1959) pp. 159-67. In French.

The replacement of bromide by chloride ions in emulsion is described. Details of the preparation are given and the factors influencing grain size, background and sensitivity discussed. Illustrations of the resolution of the emulsion are given for protons and α-particles at the end of their ranges. It is concluded that such emulsions can be made with reproducible properties, and that these can in principle be modified by the use of suitable sensitizing agents. S.J.St-Loran

778.34

13994. THE FORMATION OF THE LATENT IMAGE BY NUCLEAR PARTICLES. W.F.Berg.

ticle photography" conference, Strasbourg, 1957 (see
r. 11704 of 1959) pp. 93-8. In French.
The paper is a summary of a more general review covering the
anisms involved in the formation of a latent image by charged
cles. Attention is drawn to the primary stage of image forma-
the characteristic curves, the discriminating power, the back-
nd and the overall sensitivity of the emulsion. S.J.St-Lorant

778.34

5. WORK ON NUCLEAR EMULSIONS AT THE UNIVERSITY
MONTREAL. P.Demers.
ticle photography" conference, Strasbourg, 1957 (see
r. 11704 of 1959) pp. 99-105. In French.
Gives a brief summary of recent published work by the Group
ne preparation and properties of special emulsions.
S.J.St-Lorant

778.34

6. A COMPARISON METHOD FOR THE MEASUREMENT OF
SENSITIVITY OF NUCLEAR EMULSIONS. W.Markocki.
ticle photography" conference, Strasbourg, 1957 (see
r. 11704 of 1959) pp. 107-13. In French.
A rapid sensitometric method, based on the estimation of the
all blackening produced by particles is described. Measure-
ts are made by reflected light on emulsions which have been
loped and dried, but which remain unfixed. Although the
od yields relative results only, an advantage is that exposure
y species of particles may be made. S.J.St-Lorant

778.34

97. RECIPROCITY FAILURE IN THE PRINCIPAL NUCLEAR
ULSIONS AND ITS INTERPRETATION IN THE HYPOTHESIS
A VARIABLE DISTRIBUTION. R.Schmitt and F.Simon.
rticle photography" conference, Strasbourg, 1957 (see Abstr.
04 of 1959) pp. 115-23. In French.
A study is made of the response of different commercially
llable nuclear emulsions to exposures of light of variable
nsity and duration. It is hoped that this method approximates most
sely to the actual conditions under which the latent image is
duced by charged particles. An exposure range from 28 min to
s than 10^{-6} sec is covered, filtered light at λ = 3660 A being used.
omparison of the results with the theory of a variable distribu-
of the latent image is made. S.J.St-Lorant

778.34

98. THE LATENT IMAGE IN NUCLEAR EMULSIONS AT LOW
MPERATURES. M.Debeauvais-Wack.
rticle photography" conference, Strasbourg, 1957 (see
tr. 11704 of 1959) pp. 125-30. In French.
The latent image formation at -186^0, -85^0, and 20^0 C is studied
number of types of emulsion exposed to α, β and γ particles.
omparison with the effect of brief exposure to ordinary light is
de. S.J.St-Lorant

778.34

99. THE HERSCHEL EFFECT AND FADING IN NUCLEAR
ULSIONS. M.W.Meier and K.Lanius.
rticle photography" conference, Strasbourg, 1957 (see
tr. 11704 of 1959) pp. 131-2. In French.
The behaviour as a function of time of the latent image produced
γ-irradiation is studied in Agfa K2 nuclear emulsion.
S.J.St-Lorant

778.34

00. THE PREPARATION OF NUCLEAR PHOTOGRAPHIC
ULSION SENSITIVE TO MINIMUM IONIZING PARTICLES.
.Bogomolov, A.A.Sirotinskaya, M.U.Deberdeiyev and
M.Ouvarova.
rticle photography" conference, Strasbourg, 1957 (see
tr. 11704 of 1959) pp. 133-44. In French.
An outline but without actual experimental details of the
paration and properties of the special emulsions currently in
at the Institute NIKFI, and a discussion of the possible factors
ating to the sensitivity. S.J.St-Lorant

778.34

01. A NUCLEAR EMULSION BASED ON POLYVINYL ALCOHOL.
emers and A.K.Schwerin.
rticle photography" conference, Strasbourg, 1957 (see
tr. 11704 of 1959) pp. 145-8. In French.

Describes without details the results of current attempts to replace the gelatine of the emulsion by polyvinyl alcohol. Some of the properties of such an emulsion are discussed.
S.J.St-Lorant

778.34

14002. NEW EMULSIONS SENSITIVE TO PARTICLES, X- OR γ-RAYS. J.M.Blum.
"Particle photography" conference, Strasbourg, 1957 (see Abstr. 11704 of 1959) pp. 149-57. In French.
The properties of two new emulsions are described which register ionizing particles in arbitrary colours. The selected colour is the representation of the variation of one parameter say the wavelength or the ionization. The first type of emulsion is based on the principle of subtractive synthesis of light and it displays the variation in wavelength of the incident light by a variation in colour in an emulsion sandwich. As an illustration the formation of Laue patterns by some elements is shown. The other emulsion is essentially a uniform mixture of gels of different sensitivity, and containing different dyes. Such an emulsion is developed by standard colour processing techniques; particles are separated by the number and type of grains which may be identified by their colour.
S.J.St-Lorant

778.34

14003. A STUDY OF EMULSIONS OF THE DEMERS TYPE. A.Oliver.
"Particle photography" conference, Strasbourg, 1957 (see Abstr. 11704 of 1959) pp. 169-72. In French.
Describes briefly results of an attempt to find the optimum conditions, in particular the quantity of sensitizer added, as a function of the resulting grain density, in the preparation of ultra-fine grain emulsions. S.J.St-Lorant

778.34

14004. A COMPARISON OF VARIOUS METHODS OF INCREASING THE DISCRIMINATION OF NUCLEAR EMULSIONS. C.S.Bogomolov and A.A.Sirotinskaya.
"Particle photography" conference, Strasbourg, 1957 (see Abstr. 11704 of 1959) pp. 173-81. In French.
A summary is given of some methods whereby the resolving power of emulsions may be enhanced by modifications in composition or processing, rather than by means dependent on the physical properties of specific particles. Three groups are considered: methods based on the variation of the constituents of the emulsion during the preparation, methods depending on the modification of the latent image, and methods associated with special procedures during development. S.J.St-Lorant

778.34

14005. THE DENSITY AND COMPOSITION OF ILFORD G5 NUCLEAR EMULSION. A.J.Swinnerton and C.Waller.
"Particle photography" conference, Strasbourg, 1957 (see Abstr. 11704 of 1959) pp. 183-94. In French.
Describes the determination of the density and the percentage composition of Ilford G5 emulsion in equilibrium under conditions of one atmosphere and 58% relative humidity. Methyl salicylate is used as reference liquid. The effect of the variation of relative humidity on the density is discussed. Analogous properties of other emulsions derived from the same source are discussed.
S.J.St-Lorant

778.34

14006. FADING OF THE LATENT IMAGE OF TRACKS PRODUCED BY WEAKLY IONIZING PARTICLES. C.S.Bogomolov and K.M.Romanovskaya.
"Particle photography" conference, Strasbourg, 1957 (see Abstr. 11704 of 1959) pp. 195-201. In French.
Attempts to establish a relation between the fading properties of the latent image and the energy of the particles producing it. A control emulsion stack is compared with one where the fading process is artificially enhanced. It is shown that in the region of 1 to 4.6 times minimum ionization the degree of fading is almost independent of the particle energy. It is mentioned that there exists a certain small decrease of fading with an increase in ionization and a simple theoretical interpretation is offered.
S.J.St-Lorant

778.34

14007. ON THE PHOTOGRAPHIC ACTION OF CHARGED PARTICLES AT LOW TEMPERATURES.

C.S.Bogomolov, I.F.Rasorenova and A.A.Sirotinskaya.
"Particle photography" conference, Strasbourg, 1957 (see Abstr. 11704 of 1959) pp. 203-11. In French.

A description of the behaviour of nuclear emulsions at low temperatures is given. The mechanism causing a decrease of emulsion sensitivity with a decrease in temperature is analysed and the effect of precooling at different temperatures studied. The fluorescence effect, at low temperatures a characteristic of mixed crystals of silver iodide and bromide is investigated over a range of concentrations of the components. It is shown that emulsion containing no iodide ions is considerably more sensitive to high energy particles at low temperatures than emulsion of normal composition under the same conditions. S.J.St-Lorant

778.34

14008. THE QUANTITATIVE RELATIONS GOVERNING THE PHOTOGRAPHIC ACTION OF CHARGED PARTICLES AT LOW IONIZATION. C.S.Bogomolov.
"Particle photography" conference, Strasbourg, 1957 (see Abstr. 11704 of 1959) pp. 213-31. In French.

It is attempted to establish the relation between the grain density of tracks due to charged particles and their ionization as a function of the chief parameters which may be used to describe emulsion. This approach is based on a statistical treatment of fluctuations of so called "primary ionization" in the microcrystals of the emulsion. It is shown that the number of primary ionizations is directly proportional to the specific energy loss of the incident particles. Results from different types of emulsion are used to illustrate this proportionality. Variations in grain size, as determined by electronic sensitometry are discussed in the light of the proposed model. S.J.St-Lorant

778.34

14009. SOME INTERESTING PROBLEMS OF TECHNIQUE IN THE INVESTIGATION OF PROCESSES AT HIGH AND VERY HIGH ENERGIES WITH STRIPPED NUCLEAR EMULSIONS.
G.B.Zhdanov.
"Particle photography" conference, Strasbourg, 1957 (see Abstr. 11704 of 1959) pp.233-39. In French.

Suggests a number of specific points to which special study should be devoted, in particular "emulsion chambers", the coupling of counters with emulsion stacks and the elimination of distortion. A plea is made for better coordination of research involving large volumes of emulsion. S.J.St-Lorant

778.34

14010. WHAT USERS EXPECT FROM THE MANUFACTURERS OF EMULSION. G.P.S.Occhialini.
"Particle photography" conference, Strasbourg, 1957 (see Abstr. 11704 of 1959) pp. 241-6. In French.

Presents a table of the properties of emulsion, and suggests possible remedies whereby manufacturers could suppress certain undesirable features. S.J.St-Lorant

778.34

14011. AN IMPROVED ISOTHERMAL METHOD FOR THE PROCESSING OF THICK NUCLEAR EMULSION PELLICLES.
H.Yagoda.
"Particle photography" conference, Strasbourg, 1957 (see Abstr. 11704 of 1959) pp. 247-54. In French.

Uniform development of emulsion pellicles 1500 μm thick is obtained by processing unsupported pellicles between sheets of thick absorbent paper which ensure access of solutions from both sides. The absence of the hot stage reduces distortion. Minimum ionizing tracks have a grain density of 15 ± 4 grains/100 microns, the number being dependent on the age and the sensitivity and the temperature of treatment of a particular batch of emulsion. A high degree of uniformity throughout the volume of the emulsion is achieved by a series of compensating baths of controlled pH. A simple method of cleaning, drying and mounting the pellicles is described. S.J.St-Lora

778.34 : 539.1.

STUDY OF THE LOADING OF SOME NUCLEAR EMULSIONS BY BORON AND LITHIUM. See Abstr. 13526

778.34 : 539.1.

14012. THE USE OF NUCLEAR EMULSIONS FOR NEUTRON SPECTROMETERS. L.Rosen.
"Particle photography" conference, Strasbourg, 1957 (see Abstr. 11704 of 1959) pp. 357-8. In French.

Briefly reviews the several applications of nuclear emulsions to neutron spectroscopy in the range of energy of 50 keV to severa tens of MeV. S.J.St-Lora

778.34 : 539.

14013. THE SCOPE OF NUCLEAR EMULSIONS IN THE SPECTR ANALYSIS OF NEUTRONS FROM REACTORS. C.Beets.
"Particle photography" conference, Strasbourg, 1957 (see Abstr. 11704 of 1959) pp. 359-70. In French.

The determination of the energy distribution of fast neutrons reactors is described, by making use of the (n,p) reaction and observing the recoil proton spectrum in an emulsion camera. The optimum disposition of the emulsions is discussed and a detailed description of the technique for evaluation of the events is given. The reproducibility and speed of the method is considered. S.J.St-Lora

778.34 : 539.

14014. MEASUREMENT OF NEUTRON FLUX USING A [LOADED NUCLEAR EMULSION PREPARED FROM GEL.
M.Juric, D.Winterhalter and M.Dordevic.
"Particle photography" conference, Strasbourg, 1957 (see Abstr. 11704 of 1959) pp. 385-90. In French.

Describes the preparation of emulsions loaded with various substances, starting with the commercially available gel. The neutron flux is measured by counting the number of α-particle tracks from the B(n,α) reaction in a given volume of boron loaded emulsion, assuming a uniform distribution of the added element. The use of uranium loading is described and the desensitizing effe of uranyl ions noted. S.J.St-Lora

778.34 : 57

14015. THE METHOD OF "TRACK-HISTOPHOTOGRAPHY".
R.Rechenmann.
"Particle photography" conference, Strasbourg, 1957 (see Abstr. 11704 of 1959) pp. 417-19. In French.

Gives a full description of the technique of applying the emulsi in gel form to a selected specimen, drying, exposure and development of the specimen–emulsion sandwich. Necessary precautions during the processing are underlined and the means of staining and observation of the specimens suggested. The use of the method is illustrated in several coloured plates drawn from the field of biolo S.J.St-Lora

778.34 : 6

14016. MEDICAL APPLICATIONS OF THE "TRACK-HISTOPHOT GRAPHY" METHOD. C.M.Gros and C.Gegauff.
"Particle photography" conference, Strasbourg, 1957 (see Abstr. 11704 of 1959) pp 419-21. In French.

Lists current research projects in France where the method has found application. S.J.St-Lora

778.34 : 537.59

EMULSION CONTAINERS FOR COSMIC RAY RESEARCH IN HIGH-ALTITUDE ROCKETS. See Abstr. 13404

LIST OF JOURNALS

The following list supplements the List of Journals published with the Index to Volume 61 (1958). Reprints of the List of Journals can obtained from The Institution of Electrical Engineers, Savoy Place, London, W.C.2, price 2s.0d. post free.
The addresses given are believed to be correct at the date of publication, but no responsibility can be accepted for errors.

gen.-Arch.	Ingenieur-Archiv Springer-Verlag, Heidelberger Platz 3, Berlin-Wilmersdorf; Neuenheimer Landstrasse 28-30, Heidelberg.
strum. Pract.	Instrument Practice (Automation and Electronics) United Trade Press, 9 Gough Square, Fleet Street, E.C.4.

NEW JOURNALS

rtemporary Physics	Contemporary Physics Taylor and Francis, Red Lion Court, Fleet Street, E.C.4. Vol. 1, No. 1 dated October, 1959.
t. Bur. Stand. Monogr.	National Bureau of Standards Monograph Government Printing Office, Washington 25, D.C. No. 1 issued Sept. 10, 1959.

ERRATA

Abstr. 9782 (1954) line 1 : for "$Cs_2I_8(Cs_4I)$" read "$Cs_2I_8(CsI_4)$".
Abstr. 729 (1956) line 3 : for "T.H.Blewett" read "T.H.Blewitt".
Abstr. 1361 (1959) line 2 : for "E.O.Devyatkova" read "E.D.Devyatkova".
Abstr. 5157 (1959) line 2 : for "G.Kuwababa" read "G.Kuwabara".
Abstr. 6504 (1959) line 3 : for "K.Nishjima" read "K.Nishijima".
Abstr. 7311 (1959) line 10 : for "The accuracy if the measurements" read "The accuracy of the measurements".
Abstr. 7621 (1959) line 3 : for "Vol. 19" read "Vol. 10".
Abstr. 9483 (1959) line 20 : for "9.01" read "0.01".
Abstr. 9701 (1959) line 14 : for "Griberg" read "Grinberg".
Abstr. 9723 (1959) line 7 : for "The Na^{+++} ion current follows a square law" read "The Na^{++} ion current follows a square law".
Abstr. 9815 (1959) line 15 : for "absorbed" read "adsorbed".
Abstr. 9901 (1959) line 2 : for "R.Giaconni" read "R.Giacconi".
Abstr. 9963 (1959) line 2 : for "K.H.Yiglane" read "Kh.Yiglane".
Abstr. 10590(1959) line 6 : after "The cross-section of" insert "the process discussed in".
Abstr. 10800(1959) line 2 : for "Muchtarov" read "Mukhtarov".
Abstr. 10868(1959) line 2 : for "Ryaznov" read "Ryazanov".
Abstr. 12271(1959) line 3 : for "Schillman" read "Schillmann".
Abstr. 12316(1959) line 8 : for "25W" read "2.5 W".

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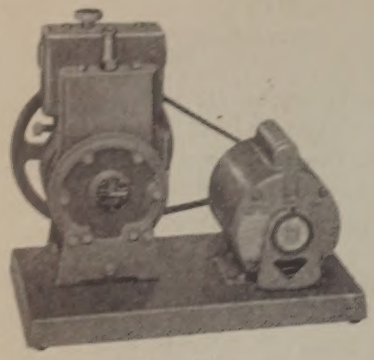

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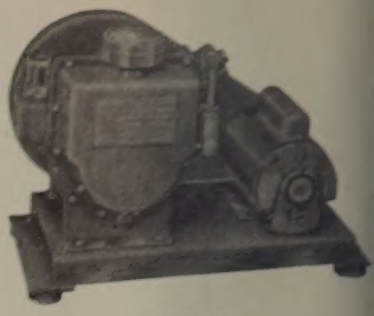
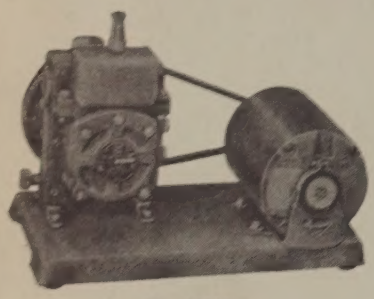


No. 1397B



No. 1400B

No. 1392

No. 1402B

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3. 1402B—two-stage, vented exhaust, 0·1 micron, 140 liters per minute. $310.00

4. 1397B—two-stage, vented exhaust, 0·1 micron, 375 liters per minute. $645.00

5. 1392—mechanical and diffusion pump assembly, two-stage (each element) 0·001 micron, 600 liters per minute. (at 0·1 micron) $275.00

6. 1403B—single-stage, 5 microns, 100 liters per minute. $245.00

No. 1403B

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